ELECTRICAL REVIEW

ILLUSTRATED.

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Electric Light, Power, Telephone, Telegraph and Scientific Progress.

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VIEWS, NEWS AND INTERVIEWS.

The American girl is not slow to grasp a chance. Some time ago *The Ladies' Home Journal*, of Philadelphia, organized a free education system for girls, and the maga zine is now educating some 40 odd girls at Vassar and Wellesley Colleges, and at the Boston Conservatory of Music, all the expenses of the girls being paid by the *Journal*.

"The Plattdeutschenvogelschuetzengesellschaft contemplate taking a trip in the near future over the line of the Electrictischesstrasseeisenbahnwagengesellschaft." — *Kenton Herald*.

Sir William Thomson's full title has now been officially announced as "Baron Kelvin, of Largs, in the County of Ayr," Scotland.

A long-haired man drifted into the lobby of the Iroquois Hotel during the progress of the electric light men's convention last week and stood around on the edge of the crowd for a time. Finally, he stepped over to a place where a number of electricians were conversing, and said: "Electricians, I presume."

"We are," admitted one of the party.

"Know the difference between a volt and an ohm, without doubt?"

"Yes, sir."

"Can tell an automatic cut-off from a reduction coil instantly, I have no hesitancy in saying."

"Certainly."

"Well, then, gentlemen, you are the people that I am looking for. I am an electrician myself and I have no trepidation in saying that Thomas A. Edison is not in it with me. He is something of an inventor, to be sure, but beside me, gentlemen, his light pales as does a tallow dip in the glare of the mid-day sun. I have perfected an invention, after years of patient toil, that will interest you scientific men and I would like to explain its workings to you."

"Fire ahead," said a motor man.

"You all know that heat is one of the products of electricity. By application of that heat I will make millions. Doubtless, you have, in the Summer time, visited some of the gay watering-places on our coasts and seen disporting in the waters the hundreds of bathers. Now, I have perfected an invention by which, with the aid of electricity, I can warm that water in the Winter time and thus make it possible for ocean bathing to go on all the year around. It means millions to the hotel-keepers at these resorts, for who, on a cold January day, would not enjoy a dip in the warm sea waves when he could get it without going to Florida after it? It's a great thing, gentlemen, and I am prepared to let you all in on the ground floor."

"Yes," said a carbon maker, "but how the devil are you going to warm the air. Your invention is no good unless that can be done."

"Excuse me, sir, but I can't bother with such little details as that. I warm the water and somebody else will have to look out for the atmosphere. Now, gentlemen, I have here a book of stock which I offer to you at a very reasonable figure, 10 per cent. payable now. How many shall I put you down for?"

"I don't think that we will go into it," said one of the party.

"It's a chance to make millions and you can get the stock cheap."

"Can't use it."

"Well, of course, you are the architects of your own fortunes. If you don't want money, I won't force it on you. By the way, can any of you gentlemen lend me a cigarette? No? How about the price of a drink? No? Well, good day, gentlemen. Come down and bathe with me when I get her going."—*Buffalo Express*.

Wisconsin Electric Club.

Members of the Wisconsin Electric Club had a quiet but enjoyable celebration on the evening of the 18th ult., the occasion being the successful completion of the university extension course of lectures on electricity. Refreshments were served at the club rooms, and short speeches were made by President Johnson, Secretary Boggis, Prof. A. J. Rogers, C. D. Parker, and Messrs. Bradshaw, Fountain and others. It was officially reported that the lectures had yielded a snug sum. It was decided to augment the amount from the club's general fund and purchase additional books for the library.

WORLD'S FAIR NOTES.

The grand entrance to the mammoth Manufacturers' Building will be decorated at an expense of about $12,000.

A heroic statue of Columbus, by Louis St. Gaudens, will stand before the main entrance of the Administration Building.

Mrs. Frona Wait, one of the lady managers of California, has offered to finish in redwood one of the large reception rooms in the Woman's Building.

A Choral Hall, 160x260 feet, will be erected near the Horticultural Building.

FIG. 1.—UNIQUE ELECTRIC LIGHTING FIXTURES—ELECTROLIER AT TENDERLOIN CLUB, NEW YORK.

National Electrical Manufacturing Company.

Owing to the large business done by the National Electrical Manufacturing Company, of Eau Claire, Wis., it has been found necessary to enlarge their present plant.

The capital stock has been increased to $300,000, and important changes will be made perfecting their facilities. At the annual meeting of the directors the following officers were elected: President, Peter Truax; vice-president, C. A. Daigh; secretary, R. E. Rust; treasurer, Geo. T. Thompson; general manager, Geo. B. Shaw.

The directors are. Peter Truax, C. A. Daigh, R. E. Rust, Geo. T. Thompson, Eugene Shaw, Fitch Gilbert, J. T. Barber.

This company is meeting with much success under the able and far-sighted management of Mr. Shaw.

There Professor Tomlins, with 2,000 trained voices, will furnish rare choral music during the Exposition. The Welsh International Eisteddfod will occupy the building for a week.

A bill protecting foreign exhibitors of patented articles from all possible prosecution for infringement has been passed by the Senate, and is pending and reported sure to pass in the House. The bill reads as follows:

"That no citizen of any country shall be held liable for the infringement of any patent granted by the United States or any trademark registered in the United States where the act complained of is performed in connection with the exhibition of any article or thing at the World's Columbian Exposition at Chicago."

Unique Electric Lighting Fixtures.

To one who has not studied and followed the development of electric lighting fixtures, it would seem that ideas for odd effects in this branch of the electrical industry had been almost exhausted. But the truth of the matter is, that the adapting of the electric light to local effects has scarcely commenced; and, moreover, it will never end. The diversity of uses to which the electric light may be put, and the constantly varying conditions of each new installation, will ever furnish the electrical engineer with new opportunities for the exercise of his ingenuity and give the fixture artist occasions for the exploiting of his talents. There would seem to be no restriction as to the materials to be employed. Whatever may be of service will be turned to account.

Four examples of what has been done in this line are represented in the accompanying illustrations. Each is unique and possesses distinct characteristics of its own.

The readers of the ELECTRICAL REVIEW have doubtless heard of the Tenderloin Club, of New York. It is a famous organization and there is nothing like it in the heavens above, the earth below or the waters beneath. It stands alone as the Bohemian Paradise of New York. Its membership is composed of a large number of newspaper men, musicians, artists, actors and geniuses, and includes some of the brightest intellects to be found in that large and forceful contingent of the metropolis which has "a disregard for the conventionalities of society." The Tenderloin Club is, as a member explained at one of its "beefsteak suppers," a club "without purpose, politics or precedent."

In the largest room in the club house hang two chandeliers just alike. The sketch, Fig. 1, shows one of these. The character of the club is evidenced in these fixtures—they are artistic and unique. Each is composed of half an oaken cask, the natural color of the wood being preserved. Extending out are the light arms, each surmounted by a German beer mug or "stein." Out of these "steins" the lights project. These chandeliers are the work of the Mitchell-Vance Company, of New York. Gas is used for illuminating purposes at present, but in the near future electricity will probably be employed.

The fixture shown in Fig. 2 is an example of the designs used for lighting the "cork room" of a well-known New York music hall. The idea is certainly odd and undoubtedly appropriate. The fixture, which is used as a wall bracket, is composed of a bronze plate chased in designs representing clusters of grapes out of which extends a bronze arm and hand grasping a champagne bottle. The glass of the bottle is white and a 16 candle power incandescent lamp is placed inside. The effect is extremely unique and artistic.

Another excellent example of the adapting of the electric light to local effects is shown in Fig. 4, which represents the central fixture in the "Yacht Room" of the Arena, a favorite restaurant of New York's *jeunesse doree*. The decorations of this room consist of yacht club flags, fish nets, canoe sails and marine pictures. The whole atmosphere of this cosy place is briny. What design could

be more appropriate for a lighting fixture than a ship's anchor? The anchor itself is made of wood covered with silver paint. Sea grass falls from its angles and helps to support clam shells, out of which project the incandescent lamps. A great deal more light is shed from this fixture than might be supposed.

A beautiful example of wrought iron work is illustrated in Fig. 3, which shows one of several wall brackets used in the café of the New York Electric Club. This, as well as all the other fixtures in the club, which are marvels of workmanship and artistic beauty, were made by the Thackara Manufacturing Company, of Philadelphia. The present example more nearly approaches the conventional than any of the others already described, and yet it is distinctly unique. It is made of black Swedish iron and the gorgons and curved parts twist and twine together in artistic harmony.

These instances exhibit but a few of the possibilities in artistic and unique fixture lighting. In the case of the working electrician, "everything is fish that comes to his net." Under his direction beautiful and practical lighting fixtures can be made of anything, from beer kegs to cut glass.

Electricity.

It was a favorite saying of Zollner's that the great difference which he found between educated and uneducated people was that the latter accept all the phenomena of nature as matters of course, while the former find themselves encompassed with riddles, seeming contradictions and wonders. Just as, until Newton, no one wondered that the apple fell to the ground, so to-day the great majority of people discourse about electricity, magnetism, electric currents, electric machines, etc., in so familiar and matter-of-fact a manner as to intimidate inquiries, without realizing how very meagre is our knowledge of the essence or substance of electricity and its relation to other natural forces or manifestations of force. It is true that in physics we talk about positive and negative electricity, about an electric fluid, etc., but this "fluid" is only a word which serves our purpose in the absence of more exact knowledge. Is there such a thing as electricity? And, if so, what is it? What is this puzzling, invisible, imponderable so-called fluid which courses through the telegraph wires? What force is in the cable that connects the machine with the dazzling electric light? There is nothing on the wire to indicate to the naked eye whether the electric current flows through it or not. There is no change of color and no appreciable change in its taste or temperature; nevertheless, a wonderful something from without operates in it. If I hold my watch near it, under certain conditions, it will be stopped and permanently damaged. If I file the wire thinner in any spot, it becomes heated to redness. If I cut the wire through, a shower of sparks spurt out, accompanied with flashes of light dangerous to life, and in all respects resembling lightning. The mystic force disappears as rapidly as it comes, traversing thousands of miles in a second. These are facts with which every schoolboy is acquainted, but the more familiar the phenomena, the more painful for the thinking man is the uncertainty as to its essence and its relations. An electric stream flowing through a wire is interrupted if the wire be cut; and in 1831 Faraday made the remarkable discovery that at every opening and closing, an electric current of short duration was set up or "induced" in every metallic body in the neighborhood. This appeared at first glance to indicate that the electric force was capable of operating at a distance, without any channel of communication. Faraday, however, was convinced that this was no adequate explanation, but that the transit of the fluid was accomplished by the mediation of some unknown conductor. But if electric induction is dependent on some medium in space, the question arises, should not experiments afford evidences of it, by enabling us to determine the speed of transit, and further, what is the transit medium? Federson was the first to discover that the transit of electricity from point to point was not instantaneous, and recalling what was said above as to all metallic bodies in the neighborhood of the cut wire becoming subjects of induction, is it not reasonable to infer that the operation is conducted by a species of waves of motion? An analogous instance to the transit of electricity through space is afforded by the following very familiar phenomena: The reader will almost surely have remarked that on opening the door of a room suddenly, a hinged window on the opposite wall sprang open. To the man unaware of the existence of air, the phenomena must necessarily suggest the idea of force acting at a distance, but with our knowledge of air and its properties the explanation is simple; the opening of the door sets in motion waves of air, which, reaching the window, act mechanically upon it. Electric induction is now explained by a similar hypothesis. The principal worker in this field has been Professor Hertz, now of the University of Bonn, whose experiments and deductions are of epoch-making significance, and whose views may be concisely stated as follows: We may now deem it extremely probable that there is no such thing as electricity or magnetism in the sense in which it has been hitherto conceived, viz., as a certain imponderable fluid, attracting and repelling from a distance, but rather that light, heat, magnetism are electrical phenomena; or otherwise that light, heat, electricity, magnetism are kindred phenomena, all depending on the motion of the ether, which we think of as invisible and of incalculable tenuity, penetrating all bodies and filling space. It is clearly evident that electric induction is not immediate, nor due to a force springing through space from point to point, but that it requires measurable time in transit, and that its extension is similar to that of

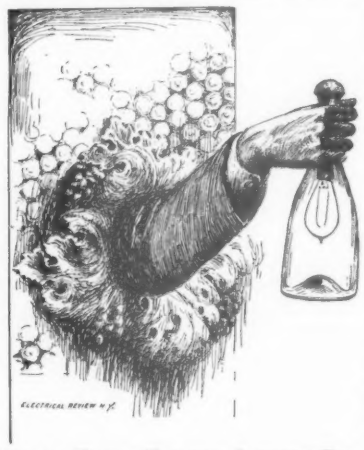

FIG. 2.—UNIQUE ELECTRIC LIGHTING FIXTURES.—KOSTER & BIAL'S CORK ROOM, NEW YORK.

light and heat, viz., by waves of motion. We have no space here to enter on the details of Hertz's interesting investigations as to the relations of electricity to heat, light, optics, etc. Suffice it to say that his discoveries have created considerable excitement in scientific circles, opening up a vast intellectual perspective. In all cases, wherever light, heat and chemical action are operative, he has rendered it evident electricity is also active. Let us imagine that at this moment the sun, hitherto darkened, shines forth in its brilliancy; thousands and tens of thousands of waves of ether burst forth, permeating space in all directions; a small portion of these waves reach the earth; each single wave is made up of portions of waves of all sorts, some with especially short, some with especially long waves, some powerful, some weak, some polarized, some unpolarized, comparable to the varying waves of sound which fall on the ear when a band strikes up. The very short waves, with wave lengths the thousandth part of a millimetre, exert themselves in chemical action, as on photographic plates, and in the functions of organic life; those of greater wave length are apprehended by the eye as light, appearing, according to their length, as violet, indigo, blue, green, yellow, orange, red. They strike on the retina and generate the preception of light and color. Even waves of this length generate a measure of warmth in their activity, and all these, along with waves whose lengths can be measured by meters and kilometres are of electric nature, while the waves of utmost length manifest themselves probably in the Northern Lights, which flash from pole to pole, similar to what is to be observed on the planet Venus. If the question is now again asked: What is electricity? we may reply advantageously, in the words of Jokai: A thing of which we know a little more than nothing, and a little less than something. A little more than nothing, for we know that it is of the nature of light and heat, extending itself, like them, in waves of motion. A little less than something, for of the essence of electricity itself, whether static or dynamic, we are still absolutely in the dark. There has been no want of either theories, but the fundamental tendency of the age is to reduce all phenomena and forces to the fewest possible primaries; and it is not improbable that this will be facilitated by the wave theory of the so-called ether. The problem of gravitation, too, which was so long regarded as a force acting from a distance, is now equally attributed to the agency of a medium. In his efforts to demonstrate the oneness of all natural forces, the physicist is not likely to be led astray, even although the cognition of force presents one of those world problems the solution of which must forever escape us; aye, although, as a final result of the most exact investigation, it should forever be denied to him even to assert decisively: "It is only a force, and the ether is its medium of transmission."—*Carl Grang.*

JUST READ THESE!

A Few Kind Words Out of Many Hundreds.

"HAS CONTRIBUTED LARGELY TO THE PROMOTION OF ELECTRICAL INTERESTS."

[*From Frank Leslie's Illustrated Weekly.*]

The ELECTRICAL REVIEW, the first electrical weekly newspaper published in the United States, celebrated its tenth anniversary by issuing a specially illuminated number devoted to the rehearsal of its own history and embodying a review of the various stages of electrical development during the last decade, with a large amount of other matter. The REVIEW has contributed largely to the promotion of electrical interests in this country. Now that the science of electricity has reached such a full development, and the industries of the world are becoming so intimately dependent upon it, it must afford the proprietors of that journal great satisfaction to recall the important part they have played in the achievement of these great successes. The Decennial Number is handsomely illustrated by portraits of men who are prominent in the electrical world.

"PRESERVE FOR FUTURE REFERENCE."

[*From the American Machinist.*]

The ELECTRICAL REVIEW celebrates and signalizes its tenth birthday anniversary by publishing a special number that is remarkable for its beauty, the number and elegance of its illustrations, and for the vast amount of information given with regard to electrical matters. It is safe to say that most of those who are at all interested in electricity will want to preserve it for future reference.

"PRACTICALLY A HISTORY OF ELECTRICITY."

[*Commercial Advertiser, New York.*]

The current number of the ELECTRICAL REVIEW is an extremely handsome and interesting one, being replete in capital illustrations and full of instructive material. It is printed in celebration of the tenth birthday of the REVIEW, which was the first electrical weekly published in America. The history of this publication is practically a history of electricity. It has witnessed the growth of the telephone, the electric light, the electric railway, and discussed their progress from week to week. This Decennial Number contains among other articles the following:

"Ten Years with the Telephone," by John A. Barrett; "The Telegraph in America," by George C. Maynard; "Development of the Electric Motor," by Frank A. Perret; "The Storage Battery," by William Bracken; "The Telegraph and the Telephone," by George A. Hamilton; "Is Electricity Related to Nervous Force?" by J. J. Carty.

"ALL PERTAINING TO ELECTRICITY."

[*From Kate Field's Washington.*]

Ten years ago electricity was still in its infancy, though the telegraph flashed news around the world and the telephone had just begun to talk. To-day the National Electric Light Association

FIG. 3.—UNIQUE ELECTRIC LIGHTING FIXTURES.—THE ELECTRIC CLUB, NEW YORK.

holds a convention at Buffalo three days long with three sessions a day, and represents millions of money. There could be no greater evidence of growth than the Decennial Number of the ELECTRICAL REVIEW issued recently with 58 pages of advertising, all pertaining to electricity.

"A HAPPY AMALGAMATION OF SCIENCE, INTEREST AND INSTRUCTION.

[*Editorial in the Daily Inter-Ocean, Chicago.*]

The Decennial Number of the ELECTRICAL REVIEW, just issued in commemoration of its tenth birthday, is the handsomest class periodical of the season. It is beautifully and profusely illustrated, and its contents presents a happy amalgamation of science, interest and instruction. The growth of the ELECTRICAL REVIEW has been remarkable, and Editor Price and his associates are to be congratulated upon their success in the great field of business and electricity.

"A NOTABLE PUBLICATION."

[*The Chicago Herald.*]

The current number of the ELECTRICAL REVIEW, issued in commemoration of its tenth birthday, is a notable publication, highly creditable alike as regards make-up and contents. It is handsomely illustrated and among other features contains articles of unusual interest on the progress of a decade in the various branches of electricity. Editor Charles W. Price is to be congratulated upon the production of so attractive and valuable a number of the REVIEW.

"HANDSOMEST, MOST COMPLETE AND MOST INSTRUCTIVE OF ANNIVERSARY NUMBERS."

[*The Recorder, New York.*]

The ELECTRICAL REVIEW has made on its tenth birthday one of the handsomest, most complete and most instructive of anniversary numbers. The interest in this periodical is not confined to experts and students devoted to the most fascinating branch of applied natural science. Every intelligent person desires the information given by such articles as those entitled "Ten Years with the Telephone," "The Telegraph in America" and "Is Electricity Related to Nervous Force?" which are among the attractions of the current issue of the REVIEW.

OF INTEREST TO THE ELECTRICAL CITY.

[*The Union, Schenectady, N. Y.*]

The ELECTRICAL REVIEW recently issued its Decennial Number. The leading article was "Footprints of a Decade," a review of electrical progress during the last ten years and selections from it will doubtless interest a large number of residents of the "Electrical city."

"THAT GREAT JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS."

[*Barnesville, O., Republican.*]

The New York ELECTRICAL REVIEW of Saturday, February 20—Souvenir of the Fifteenth Convention at Buffalo—is one of the handsomest and very best issues of that great "Journal of Scientific and Electrical Progress" yet published. One of the taking lines on the grandly beautiful front page is: "Electrical Footprints of a Decade" and which will point out to you the valuable contents of this notable number of the ELECTRICAL REVIEW—of which Chas. W. Price, formerly of this place, is editor-in-chief. Twenty-five cents will get for you a copy of this number, and those looking into the science of electricity should secure a copy. We find in this number a good likeness, together with the work, of George A. Hamilton, of New York, a family friend of the writer's. It is, indeed, true that "every toiler in electrical development should be proud of his calling," and also of "a field" (and the Price) "that produces such an interesting and creditable publication as the Decennial Number of the ELECTRICAL REVIEW."

"AN ELEGANT SAMPLE OF WHAT BUSINESS ENTERPRISE AND THE PRINTER'S ART CAN DO."

[*The Elkader, Ia., Register.*]

We have on our desk a copy of the souvenir, Decennial Number of the ELECTRICAL REVIEW. It has celebrated its tenth birthday by blossoming out into an elegant sample of what business enterprise and the printer's art can do upon demand. In its pages we see the record of electrical progress for a decade and truly it reads like a fairy tale or a vision from the Arabian Nights. We sincerely wish many happy returns of the occasion to our brother of the electrical fraternity.

"MAKES HIM ASK FOR MORE."

[*Boston Journal.*]

The management of the ELECTRICAL REVIEW, published in New York, have made the Decennial Number a souvenir both of its birthday and of Buffalo. It contains, besides the usual matter of interest to the man whose head is full of amperes, volts, coulombs and currents, a description of Buffalo's varied business interests. The engravings are especially good. Considerable space is given to the progress in electrical matters during the past 10 years. One article, interesting to newspaper men, is one so short as to leave the reader with a mere taste in his mouth that makes him ask for more. Its subject is "Telegraphic Shorthand." A contributor asks the question, "Is Electricity Related to Nervous Force?" and of necessity leaves it unanswered, suggesting only that the parallels of nerve formation and methods of action with the manifestations of electrical force may indicate the method of study of this necessarily obscure question.

"PARTICULARLY HANDSOME."

[*The Chicago Mail.*]

The ELECTRICAL REVIEW, New York, the first electrical weekly published in this country, issued a particularly handsome Decennial Number, dated February 20, 1892, in commemoration of its tenth birthday. The past decade of electrical progress is interestingly presented.

"COMPARES FAVORABLY WITH THE FINEST MAGAZINE PUBLICATIONS.

[*Practical Electricity, Boston.*]

Ten years of electrical progress and development are interestingly chronicled in the 50 or 40 reading pages of the ELECTRICAL REVIEW (New York) bearing date February 20, and marking the tenth anniversary of that pioneer electrical weekly of this country. The number appears in a cover of beautiful design and delicate tints; while the greater number of interesting illustrations within, as well as the text, are presented in a very pleasing manner by reason of fine paper and excellent press-work. The number compares favorably with the finest magazine publications in point of artistic and literary merit, and is highly creditable to the publishers as well as the science of which it is the progressive and enterprising exponent.

"UNDERSTANDS THE DIGNITY AND IMPORTANCE OF ITS FIELD."

[*The Portland Transcript.*]

The Decennial Number of the ELECTRICAL REVIEW, published last week, shows the marvelous advance that has been made in electrical science as applied to almost every form of industry within the past decade. The REVIEW celebrates its tenth birthday in splendid shape It is a journal that has from the first understood the dignity and importance of the subtle agency that is transforming our industrial world, has foreseen and foretold most of its triumphs. This number is full of articles and of pictures that will interest every one who believes in electricity for light, for power and for motion. A great number of portraits of prominent electricians are given, and it is curious to note the apparent youth of most of them. The REVIEW is published at 13 Park Row, New York. Send 25 cents for Decennial Number.

"A FORCEFUL REMINDER."

[*The School Journal, New York.*]

The ELECTRICAL REVIEW, edited by Charles W. Price and published at 13 Park Row, N. Y., is devoted to the interests of electrical science. The issue of February 20 is a souvenir of the fifteenth convention of the National Electric Light Association at Buffalo, N. Y. It has various articles concerning electrical and other enterprises in Buffalo and vicinity, all fully illustrated. It also has portraits of many men in Western New York who are prominent in business and politics. Besides there is a great amount of matter relating to electrical progress in different parts of the world. Typographically, the magazine is very handsome. The illustrations are of a high quality and the numerous advertisements tasteful and artistic. The periodical is a forceful reminder of the prominent place electricity holds in the industrial affairs of to-day.

Electric Street Lighting in Chicago.

A PAPER SUBMITTED TO THE AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE BY MICHAEL MIKKELSEN, OF JOHNS HOPKINS UNIVERSITY.

In the discussion concerning the comparative merits of public and private systems of street lighting, the employment of the comparative statistical method of investigation is rendered difficult by the fact that many cities are, under unequal conditions, lighted partly by public, partly by private systems, as well as by the fact that most cities use several kinds of light, such as gas, electric, vapor and oil. It will, therefore, be expedient to examine, instead, some individual representative experiment. The experiment fixed on for this purpose is the municipal electric street lighting of Chicago. This experiment is preferred, first, because, while gas lamps still comprise 60 per cent. of all classes of lamps employed for street lighting, electricity is already the favorite means of illumination in cities of less than 100,000 inhabitants, and is rapidly supplanting other kinds of light in cities whose population exceeds that number; secondly, because the administration of municipal affairs in Chicago, perhaps more than in any other city of the first-class, is conducted on business principles, being comparatively free from the influence of federal politics.

The first attempt to establish a municipal electric lighting plant in Chicago was made about 12 years ago, when Mr. John P. Barrett, superintendent of the city telegraph, procured a small dynamo and connected it with an engine in the North Side Water Works, two arc lights being placed on the cupola of the tower. The enterprise met with opposition, however, and the city council directed the dynamo to be sold and the lights to be taken down, which was accordingly done.

The next attempt was made in 1887. In this year a small appropriation was granted for the purpose of lighting up the river front. A small outfit was purchased and operations begun in an abandoned fire engine house. A limited number of lamps was erected, commanding not only the river, but also bridges and viaducts. The effect upon the dark narrow stream, dangerous alike to passing vessels and belated pedestrians along the wharves, was so marked that a larger appropriation was voted, with which to illuminate some of the principal down-town streets. The superiority of electric lights was quickly appreciated by the people, and the councilmen from outlying wards, importuned by the popular demand, asked for the extension of the system. The result was that a resolution was passed to extend it to the whole city.

The plan of the system is as follows: The old city, comprising about 44 square miles, is divided into 12 electric light districts. Each district is to have a power station located as near the center as possible. From each power station a main subway is built extending across the district from boundary to boundary, and decreasing in duct space from the power station toward the boundaries. Main feeders are run out at right angles to the line of the subway; from the feeders, connections are made with the lamps. On all streets where fire or police boxes, engine houses, or police stations are located, enough duct space is provided to accommodate the underground wires of these departments. Main subways are built of multitubular blocks of bituminous concrete laid in the street, and imbedded in three inches of concrete, or simply placed on a foundation of the same material, composed of Portland cement, sand and lime-stone screenings, and are reached by large octagonal or round manholes; or they are built of cement-lined wrought iron pipes, laid in the streets and imbedded in concrete, composed of Portland cement, sand and granite screenings. The feeders throughout are two-inch iron and steel pipe, laid under the sidewalks, inside the curb wall, or in the street. Where laid in the street, small manholes and hand-holes are used.

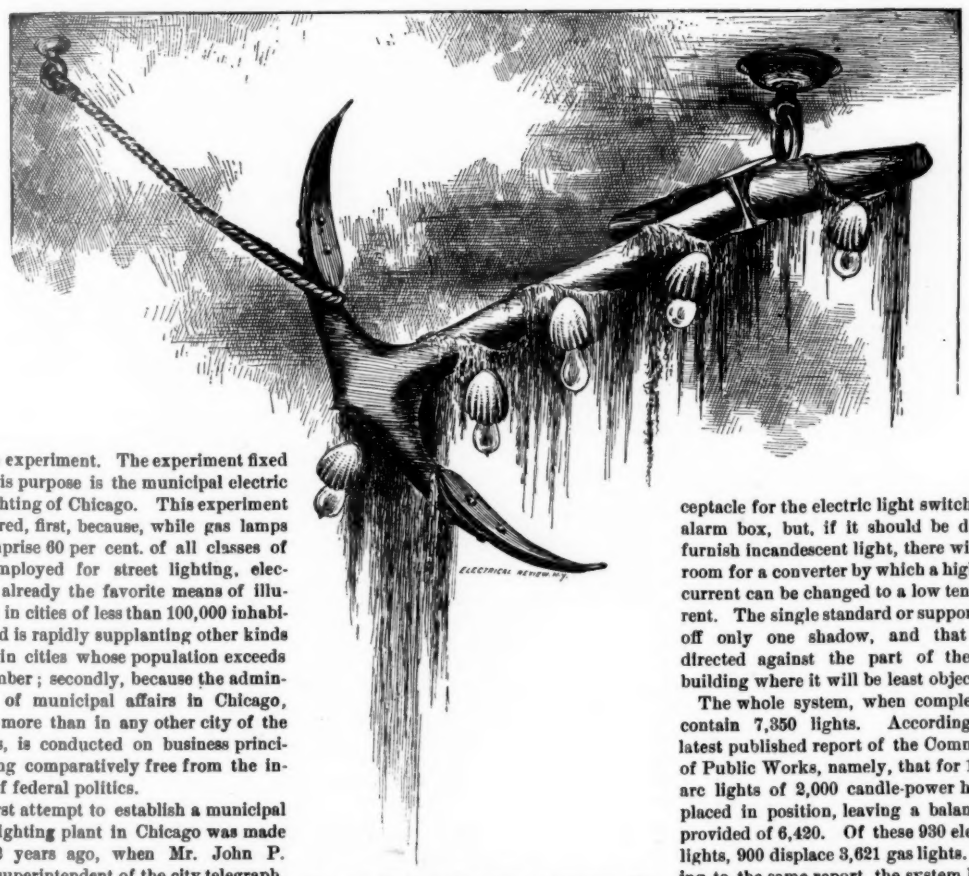

FIG. 4.—UNIQUE ELECTRIC LIGHTING FIXTURES—DESIGN IN THE YACHT-ROOM OF "THE ARENA."

The manholes are built of brick, and placed from 235 to 450 feet apart. They average about 46 inches in length by 40 in width, and range from four and a half to nine feet in depth. They are furnished with double iron covers, one of which is set below the grade and made watertight by packing; the other on a level with the street. All the iron pipe is plugged to remove burrs, and reamed at the ends. The conduits and pipes are laid with a pitch of from six inches to one foot, draining into the manholes, thus disposing of all drip from condensed moisture. The conduits are practically gas and watertight. The insulation resistance of the electric light cables is 500 megohms per mile. The electric light circuit has a voltage of from 2,500 to 3,000 volts and a current of from 9 to 18 amperes, or a voltage of from 900 to 1,200 volts and a current of from 18 to 20 amperes.

The electric light post has been designed by Mr. Barrett, and possesses some peculiar advantages. It consists of a hollow iron base extending from the sidewalk to a height of seven feet; through this hollow iron base a hollow wooden pole extends to a height of nine feet above the iron base, being securely fastened to the top and bottom of the same. There are two doors on opposite sides of the iron base, at a height of five feet from the sidewalk. Near the bottom of the base is a removable panel. A frame and hood extending from the top of the pole have but one standard or support. Inside one of the doors is placed a wooden box containing a double pole arc light switch; inside the other is a receptacle for a fire alarm box. The panel can be removed to facilitate the handling of cables.

This electric light post offers increased safety to human life, as, in case of accident to the lamp, the workman can disconnect it from the rest of the circuit by "throwing" the switch, without a possibility of contact with the conductor. The wooden pole is also a semi-insulator, and is safer to work from than an iron pole, should it be necessary to regulate the lamp while burning. Furthermore, the hollow space between the iron and wooden poles not only affords a receptacle for the electric light switch and fire alarm box, but, if it should be desired to furnish incandescent light, there will also be room for a converter by which a high tension current can be changed to a low tension current. The single standard or support throws off only one shadow, and that can be directed against the part of the nearest building where it will be least objectionable.

The whole system, when completed, will contain 7,350 lights. According to the latest published report of the Commissioner of Public Works, namely, that for 1890, 930 arc lights of 2,000 candle-power have been placed in position, leaving a balance to be provided of 6,420. Of these 930 electric arc lights, 900 displace 3,621 gas lights. According to the same report, the system has been partly perfected in four districts. The work is being rapidly pushed, $556,000 having already been expended in the organization and maintenance of the electric light service; and the whole system will probably be completed in time for the World's Fair. No district has, as yet, received its full quota of lamps.

In lighting only a portion of a district, the proportionate cost per lamp will, of course, be much greater than if the whole district could be lighted at once, as the land, buildings and subways must be provided for the entire district, while only a portion of them is used. However, the present average annual cost of one 2,000 candle-power arc light is $83—according to later statistics, in Census Bulletin No. 100, $68. The estimated average annual cost of the same light when the system shall be completed is about $50.

While, under the present unfavorable conditions, the cost of the electric lights is a trifle greater than the cost of the gas lights displaced by them, nevertheless, when the comparison is made in candle-power, an enormous difference in favor of the electric lights becomes apparent, as the following table shows:

Cost of 900 2,000 C.P. arc lights, $83.....	$74,700 00
" 3,621 20 C.P. gas lights, $20.....	$72,400 00
Total candle-power of 900 2,000 C.P. arc lights.....	1,800,000
Total candle-power of 3,621 gas lights, 20 C.P.....	72,420
Cost per candle-power for arc lights.....	$0 04
" " " " gas lights.....	$1 00

An interesting comparison might be instituted between the cost per lamp of electric light in Chicago and that of other cities, but this would, in all fairness, involve a detailed technical description of the several systems. Besides, an interesting statistical comparison, by Victor Rosewater, between public and private electric lighting systems may be found in the *Independent* for March 20, 1890. It may not be out of place, however, to state the bare fact that, according to the eleventh census, Denver is lighted at an average annual cost per electric light of $58.46, while San Francisco pays $440.67 and Boston $237.25 per light.

From the figures given above, it is evident that a saving will accrue to Chicago by the adoption of her electric lighting system. She will be better lighted and her actual expenses lessened. While she has been paying $600,000 annually to private gas companies for lighting her streets, she will in the future be able to light the same territory for a third of that sum.

Taking it for granted that public lighting is cheaper than private, for no private corporation will be found to undertake the enterprise without profit, two points remain to be considered. It has been objected that municipal ownership of electric lighting system breeds corruption and encourages inefficiency. Both of these objections may, in view of the results of the experiment in Chicago, be dismissed with a single sentence. The electric lighting service of Chicago, so far as established, is claimed by experts to be perhaps the best in existence, while not the slightest suspicion has ever attached to the honesty of its administration.

Burlington, Vt.—Consolidated Electric Company; capital, $150,000. Promoters, A. E. Richardson, W. A. Woodbury, Willard Crane, Edward A. Pope, all of Burlington, Vt.

Chicago, Ill.—Champaign Rapid Transit Company; capital, $50,000. Promoters, John Ahern, S. A. Power, Clint C. Rush. Incorporation papers sent to W. B. McKinley, Champaign, Ill.

Wallace, Idaho.—Idaho Electric Light and Power Company; capital, $500,000. Promoters, C. W. O'Neil, F. C. Loring, E. E. Lucos. Incorporation papers sent to Chas. W. O'Neil, Wallace, Idaho.

Duluth, Minn.—W. W. McMillan Company; capital, $50,000. Promoters, W. W. McMillan, W. Harwood, R. Cox, J. T. Boyd, J. J. Burns, J. P. Fairgrieves, D. L. Johnson. Incorporation papers sent to Wm. B. Phelps, Duluth, Minn.

Fort Dodge, Ia.—Fort Dodge Gas, Electric Light, Heat and Power Company; capital, $50,000. Promoters, John L. Martin, Jas. S. Cummins, Geo. M. Shearer, J. W. Campbell, L. Brandon. Incorporation papers sent to John F. Duncomb, Fort Dodge, Ia.

St. Paul, Minn.—The Northern Light Electric Company; capital, $40,000. Promoters, H. M. Byllesby, H. C. Levis, Wm. Ely Bramhall, B. F. Meek, Jr., W. P. Johnson, S. P. Wells, Jr., C. K. Stearns. Incorporation papers sent to H. C. Levis, 401 Sibley street, St. Paul, Minn.

Orange, Conn.—P. O. West Haven.—The Connecticut Pipe Manufacturing Company; capital, $30,000. Promoters, Ed. H. Phipps, New Haven, Conn.; Wm. H. Childs, Manchester, Conn.; Geo. O. Richards, West Haven, Conn. Incorporation papers sent to Francis G. Beach, New Haven, Conn.

Winona, Minn.—Winona Light, Heat and Power Company; capital, $150,000. Promoters, W. E. Bromhall, B. F. Meek, Jr., W. P. Johnson, S. P. Wellis, Jr., C. K. Stearns, H. M. Byllesby, all of St. Paul, Minn. Incorporation papers sent to H. O. Levis, 401 Sibley street, St. Paul, Minn.

Ashtabula, O.—The Citizens' Power and Light Company; capital, $5,000. Promoters, A. J. Beckwith, Ed. S. Henry, R. M. Johnson, J. B. Tophy, C. F. Schaffner, John P. Devney, H. M. Kunkle, W. S. McKinnon, E. W. Savage, A. F. Dickinson. Incorporation papers sent to A. F. Dickinson, Harbor, O.

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NEW YORK, MAR. 19, 1892.

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Everyone interested in the telephone should read Mr. John A. Barrett's instructive article on "Microphones," published in the REVIEW this week. We know of no one more competent to discuss this question than Mr. Barrett.

The Underwriters' Association of the middle department of Pennsylvania recently issued a circular, arguing the great danger of fire from electric lighting and increasing their premium 25 per cent. on electric light risks. We would advise these gentlemen to look up the subject a little more carefully before taking such hasty action, and they will find that their brother underwriters of other States, do these things better by decidedly favoring electric lighting over all other forms of illumination, when installed under the proper rules. Lay down the proper requirements, gentlemen, and pass no installation that does not meet them. These requirements are easily obtainable. The National Electric Light Association can give you a set of rules approved by a large majority of the Underwriters' Associations throughout the country. Don't be rash.

Electrical execution in New York State will soon be no more, and then will end another outrage perpetrated by would-be philanthropists in nineteenth century civilization

The REVIEW is free to say that the best editorial pencil is made by the Joseph Dixon Crucible Company, of Jersey City. "No. 342 crayon" is the kind, and it is a blessing to the tired fingers of the busy editor.

Seventy-two foreign nations and provinces have, up to the present, decided to participate in the World's Columbian Exposition. Among the latest is Bulgaria. In addition to our own exhibit, electrical exhibits from abroad promise to be large and interesting. The Electricity building is being completed most rapidly—a proper recognition of the progressiveness of the industry.

The *Standard-Union*, of Brooklyn, N. Y., is ably edited by two distinguished gentlemen, Messrs. Wm. Berri and Murat Halstead. It is a surprise, therefore, that we find that journal opposing the introduction of electric railways in the City of Churches. No truer indication of a city's enterprise and progressiveness, or lack of these elements, can be found to-day than its treatment of this question. The citizens of Brooklyn, excepting a prejudiced few, favor the introduction of electricity in place of horses, and we are pleased to state that this much-to-be-desired change is now being made, to the credit of several of her leading citizens.

Business is brought to a standstill on certain lines at the Patent Office on account of insufficient room. The Commissioner of Patents is advising those ordering copies of recently issued patents that, in consequence of want of room for storage and arrangement of printed copies, it will be impossible to fill orders until sufficient room is provided. When it is remembered that the present Commissioner and his predecessors have been beseeching Congress for years to provide the Patent Office with room enough to permit a proper transaction of business, and that the amount to the credit of the Patent Office in the United States Treasury, as its earnings, is now $4,045,753, the contempt with which the American inventor is treated, makes us blush in shame for this Government.

It would seem that the telephone raiders were not meeting with great success at Albany this year. If the editor of the New York *Recorder*, a journal that is just now espousing the cause of the alleged "subscribers'" organization in this city, will have a competent, unprejudiced reporter investigate the cost of giving telephone service in New York city, he will find that telephone rentals are not only not exorbitant, but scarcely consistent with a proper return on the capital invested, to say nothing of the extreme hazards of this business. A little common sense investigation is an admirable thing in a newspaper, and should precede sensational advocacy of a cause, apparently popular, but which has not, and does not deserve, any genuine support of the best business interests of this city.

The New York Assembly Committee on Codes has agreed to report favorably the bill of Assemblyman Stein amending the capital punishment act of the State.

The bill abolishes the execution of criminals by electricity and substitutes hanging.

The facts relating to the last execution, which were given in full detail, showed very clearly the experimental character of the whole scheme of electrical execution and, further, that the experimenters were not any nearer the solution of the problem than at first. We cannot but believe that this fact has had its effect upon all fair-minded people and that the mass of the people of the State of New York are heartily ashamed of the uncivilized position in which that fair State has been placed by Gerry and his visionary followers. We further believe that they will see to it that the scandalous work is undone.

STORAGE BATTERIES.

The improvement of the storage battery has been very much hampered in this country by the uncertainty which has existed regarding the ownership of storage battery patents. The prolonged litigation in the courts and the natural distrust of investors has prevented its introduction on a large scale and, consequently, has deprived the manufacturer of the benefit of a use of the cells in every-day work and to show the defects and indicate a remedy. The present out-look now is that peace will soon prevail in this field, that the war dogs will be called off and business become the chief aim and end. We then expect to see a very extensive use of the storage battery in special lines and a marked improvement in the general efficiency of the cell itself. Accumulators have found a much larger employment in Europe than here, owing mainly to the facts above stated, and the field of their use is widening very materially.

They have made a very excellent record recently at the Chelsea (England) Electricity Supply Company's station, in increasing the economy of output of the station by enabling the engines to work at full load whilst in operation at all, thus getting their maximum efficiency.

The losses due to the use of the battery of accumulators were, of course, quite appreciable, but the economy obtained by using the engines at full load, it is stated, considerably outweighs the losses in transformation in the battery. This field alone is a very wide one and, should further experience prove the tests of the Chelsea Company, will do much to assist the central station manager in raising his generating plant to its most economical point of operation.

There is much to be done in making the storage battery commercially a perfectly efficient tool, but we believe that much can be done and will be done by the genus "Yankee," when it comes the proper time for him to take the matter up in earnest.

PERSONAL.

D. B. Dean has tendered his resignation to the Electric Merchandise Company, to take effect April 1. Mr. Dean will hereafter be connected with the McGuire Manufacturing Company, of Chicago. We wish him every success in his new venture.

Mr. C. E. Wilson, well known from his connection with the Knapp Electrical Works, has just made arrangements to represent the Electric Merchandise Company, Chicago. Mr. Wilson's long experience and large acquaintance will make him a valuable addition to the staff of this enterprising company.

J. W. Lattig, formerly superintendent of telegraphs of the Lehigh Valley Railroad, and more recently general superintendent of the National Switch and Signal Company, of Easton, Pa., has accepted the position of general superintendent of the Electric Secret Service Company, of New York, in especial charge of their telegraph and signal department. We are told that this progressive company has a surprise in store for the railroad and telegraph fields.

Mr. F. C. Ross has accepted the position of New York manager for the Eddy Electric Manufacturing Company, of Windsor, Conn., to succeed Mr. McIntire, who has resigned. Mr. Ross will have his offices at 136 Liberty street, in the Electrical Exchange building, and is an experienced electrical man and will receive a warm welcome from the electrical fraternity in this city, and has the honor of representing one of the most successful and progressive electric companies.

The Boston *News Bureau* states that the proceeds of the new Bell telephone stock, $2,500,000, will, it is understood, be used for the extension of the long distance service and other important improvements. The subscriptions to be made payable: 25 per cent. June 1, 25 per cent. July 1 and 50 per cent. October 1.

Plans have been drawn for the erection of 10 dams in the St. Louis river, near Fond du Lac, Minn., which will give about 100,000 horse-power. One of the dams has already been completed, and two more of them are to be built before Spring. It is proposed to furnish the power from this source to all kinds of manufacturing establishments, street cars and lighting, cooking and heating in Duluth.

CONGRATULATIONS.

A FEW LETTERS FROM OUR HEAVY MAIL OF SIMILAR ONES.

"First-Class Advertising Medium."

FROM MR. A. M. YOUNG, OF THE NEW ENGLAND ENGINEERING CO.

To the Editor of Electrical Review:

My Dear Sir—Your favor of March 2 received. I wish to express my pleasure, and wish to congratulate you upon your decennial issue; it certainly is the finest electrical paper that I have ever seen, and will, no doubt, do you a very large amount of good. I shall always take pleasure in recommending your paper to my advertising friends, and, as you well know, not only on the ground of the personal goodwill and liking I have for you, but because I believe it is a first class advertising medium.

Yours truly,

A. M. Young.

Waterbury, Conn., March 7, 1892.

"Read Carefully Every Week."

FROM MR. W. R. MASON, OF THE ELECTRIC MERCHANDISE CO.

To the Editor of Electrical Review:

My Dear Sir—Your favor of the 26th ult. was received in the absence of the writer. The contents are carefully noted. At the same time, we are not greatly "complimented" at your suggestion that we state that the issue referred to was the handsomest ever produced. Do you think we are blind? Do you suppose for a moment that we cannot appreciate a good thing when we see it? The fact of the case is that the writer had the pleasure of looking through one of the copies while on an Eastern trip and at once thought that unusual compliments were due to you for the very handsome number issued. We wish this to be thoroughly understood, so that you will not claim any credit for giving us the idea in the first place. As a matter of fact, we congratulate you on the appearance of that number and also on the appearance of your weekly issue, which seems to us to be improving right along. There are so many weekly papers published at this time that we are not able to examine each one, but we can assure you, that we are pleased to read carefully the Electrical Review each week. Wishing you personally and the Review continued prosperity, we are sincerely yours,

Electric Merchandise Co.

W. R. Mason.

Chicago, March 7, 1892.

"Appearance and Character."

FROM MR. Z. CHAFEE, BROWN & SHARPE MANUFACTURING CO.

To the Editor of Electrical Review:

My Dear Sir—Your favor of February 26 and a copy of the Decennial Number have been forwarded to me from Providence, and I congratulate you upon the appearance and character of the paper. I also take this opportunity to thank you for the many attentions you have shown us.

Yours truly,

Z. Chafee.

Aiken, S. C., March 5, 1892.

"Most Representative."

FROM MR. EUGENE F. PHILLIPS, AMERICAN ELECTRICAL WORKS.

To the Editor of Electrical Review:

My Dear Sir—The Decennial Number of the Review promptly made its appearance in our office, and I must beg to offer my sincere congratulations on the successful production of what I believe to be one of the most representative editions of electrical journalism that has yet made its appearance. With the desire that the ensuing years may bring, if possible, additional prosperity, I am,

Very truly yours,

E. F. Phillips.

Providence, R. I., March 9, 1892.

"Reflects Great Credit."

FROM MR. E. E. HIGGINS, OF THE SHORT ELECTRIC RAILWAY COMPANY.

To the Editor of Electrical Review:

"We thank you for the Decennial Number; the number is a beautiful one, and certainly reflects great credit upon your management throughout."

Short Electric Railway Co.

Cleveland, Ohio.

"Good and True."

FROM C. C. HASKINS, CITY INSPECTOR, CHICAGO.

To the Editor of Electrical Review:

When the electrician has done his work and had his say, the inspector comes in and tries the installation. The Decennial Review is good and true, in material, construction and execution. Let the plant run, and may the E never drop, the C never cease to grow, and R never threaten or hinder the output of the machine.

Accept the certificate of the inspector.

Yours heartily, C. C. Haskins.

"It is the Handsomest."

FROM MR. GEORGE A. HAMILTON.

To the Editor of Electrical Review:

Dear Sir—Please accept congratulations on the success you have made of your Decennial Number. I believe it is the handsomest electrical periodical I have seen.

Sincerely yours,

George A. Hamilton.

New York, February 23, 1892.

"As an Advertising Medium."

FROM THE EUREKA TEMPERED COPPER COMPANY.

To the Editor of Electrical Review:

Please accept our congratulations upon the Decennial Number of your paper. It is very neat and is only one more evidence of your progressiveness and enterprise.

Accept our wishes for your future prosperity and assurances of our appreciation of your paper as an advertising medium.

Yours truly,

Eureka Tempered Copper Company,

Per B. E. Treenman,

Assistant Secretary.

North East, Pa., March 12, 1892.

"Pleasure and Profit from the Interesting Articles."

FROM THE CROCKER-WHEELER ELECTRIC COMPANY, NEW YORK.

To the Editor of Electrical Review:

We are in receipt of the copy of the Review issued in celebration of its tenth birthday. It is certainly a magnificent number, full of interest, and we have derived much pleasure and profit, not only from the beautiful illustrations, but also from the interesting articles. The advertising columns show the high appreciation in which your paper is held by the manufacturers of the country. When we consider the advances made in the past 10 years, what will another decade bring forth?

Crocker-Wheeler Electric Co.

New York, March 2.

Discharges Consisting of Moving Luminous Clouds.

These are experiments on the discharge of a powerful battery (electromotive force not stated) through more or less rarefied air, in which case, under certain circumstances, and especially when there is a large resistance in the circuit, a reddish or rosy flame seems to stretch out from the positive electrode and enlarge and vanish before it reaches the negative one. Analysis with the revolving mirror shows this flame to consist of a number of luminous masses or clouds, moving comparatively slowly (in one case, for example, 17 centimetres in $\frac{1}{9}$ second); or, says the author, we may equally well express it that luminous properties are communicated to successive portions of gas. The effects may be much modified by altering capacity, resistance, air pressure, diameter of tube, etc.

If the tube be small, the luminous cloud, when it reaches a certain distance from the negative electrode, will sometimes return a little towards the positive, instead of dispersing at once. Numerous instantaneous photographs were taken, which showed the moving clouds to be what might be described as a hemisphere with a conical tail; bright at the center and nebulous towards the surface. Each cloud leaves the + electrode much as a drop of water leaves the end of a glass rod, and a little luminosity remains behind on the electrode. The author suggests that if such discharges could be produced in air at ordinary pressure and given a slower motion, we might have "globular lightning." If the tube is constricted in the middle, the constriction remains luminous during the whole discharge, and acts as an intermediate electrode, *i. e.*, the clouds from the + electrode stop before they reach it, while the opposite end of the stricture gives off clouds like the + electrode. When the circuit is rapidly made and broken, the clouds vanish at the point they reached at the instant of break, and begin again at the + electrode when the circuit is made again. If, however, instead of a dead break, a large resistance is alternately thrown in and out of circuit, the luminous cloud reappears when the resistance is cut out at approximately the same place that it vanished at when the resistance was introduced.

The effect of a magnet on the discharge resembles that of a constriction in the tube; a fixed luminous cloud acting as an intermediate electrode.

General Electrical Notes.

The John Becker Manufacturing Company, have removed their office and factory from 157 Pearl street, Boston, to their fine new building, Water street, Fitchburg, Mass.

The Thomson-Houston Electric Company, of Boston, have placed before the public a new catalogue of its various types of motors. It is very effectively arranged and tastefully gotten up, as is all the literature of this company. Send for it.

The Electric Merchandise Company has just issued a pamphlet on "Electric Heating." The little book is a work of art and is being read with much interest by parties who wish to see further progress in this most convenient and economical means of heating.

The Toronto and Mimico Electric Railway and Light Company, of Toronto, Can., have given the contract for the complete electric equipment of their road to The Reliance Electric Manufacturing Company, who manufacture, in Canada, the well-known Rae standard motor.

The firm of J. Starr, Son & Company, Limited, has been incorporated at Halifax, Novia Scotia, to carry on the business of general manufacturers, dealers and importers in supplies and apparatus for telegraph, telephone and electric light installations. Their office and warerooms are at 2, 4 and 6 Duke street, and they are well equipped for an extensive business.

Light for Jerseyville.

A. R. Jackson, of Jerseyville, Ill., has secured a franchise for electric lighting at Albia, Iowa, and is now proceeding with the installation of his plant, which he expects to have in operation within 30 days. He will use Edison incandescent and Thomson-Houston arc apparatus. The Pond Engineering Company, St. Louis, has Mr. Jackson's contract for complete power plant, including a 14x13 Armington & Sims engine, with base; two 60 horse power steel boilers, Lowe heater, Blake boiler feed pump, Korting injector, tank, pipe-work, foundations, furnaces, etc. This plant will be a model one in every way.

Electrical Resistance in Connection with the Neutralization of Acids.

BY D. BERTHELOT.

Electrolytes may be divided into two groups; the first comprises all strong acids, strong bases and neutral salts. All these bodies are good conductors, even in concentrated solutions, and their molecular conductivity varies but little with dilution. The second group consists of weak acids, such as most organic ones, and weak bases, such as ammonias. In concentrated solution they conduct badly, but when much diluted, almost as well as the first group. The combinations of strong acid and strong base, strong acid and weak base, etc., are then discussed, and curves of resistance show a more or less sudden change at the point of neutralization.

The Electrical Production of Ozone.

BY DR. O. FROLICH.

After mentioning various laboratory appliances for the purpose, the author describes the plant as manufactured by Messrs. Siemens & Halske for the production of ozone on a commercial scale. The apparatus in which the discharge takes place is built up of an inner metal tube, kept cool by water, and forming the inner coating; this is surrounded by a celluloid or ebonite tube, and through the annular space between these two a continuous flow of oxygen is kept up. The outer surface of the celluloid tube has a metallic sheath which acts as the outer covering, and between which and the inner metallic tube a constant silent discharge is kept up. Ten such tubes are fixed together in a frame and joined up in parallel, both electrically and with regard to gas and water supply. An open circuit transformer is used, excited by a set of accumulators which also drive a small motor, by the spindle of which a make-and-break in the primary circuit is worked. The rapidity of make-and-break should be high, say, 600 per second. The sharper the variations in the secondary circuit the greater the production of ozone, and for a few tubes the interrupted direct current gives much sharper variations than an ordinary sine curve alternating one. When many tubes are used, however, their increased capacity affects the former and rounds its wave down to a considerable extent, while it does not appreciably affect the alternating current, which is, therefore, to be preferred when very many tubes are used. There appears to be a certain number of $\sim$ which gives a maximum of ozone. The production also increases up to a certain point with the rate of the passage of gas through the tubes, but beyond this point increasing the gas has no effect.

The amount of energy expended in the actual formation of ozone is extremely small. It makes very little difference in the total work done if the space between the tubes be filled with gas, water or highly rarefied air. A two horse-power apparatus produces about 2.4 milligrammes of ozone per second. It would greatly increase its usefulness if ozonized air could be compressed like oxygen, but this presents difficulties, as special pumps must be used. So far, the author has not got beyond nine atmospheres. Various uses of ozone are mentioned, such as disinfecting ships and buildings, destroying insects and sterilizing water, treating sewage, etc., and also for brewing purposes.

The Apparent Variability of the Electro-Chemical Equivalent of Copper.

BY J. VANNI.

Gray has pointed out that the quantity of copper deposited per coulomb varies to some extent with the current density, making the equivalent vary from .0003287, with 20 milliamperes per square centimetre, to .0003278 with 3.3 milliamperes, both at 12 degrees C., and at 35 degrees C. getting as low as .0003245. This variation he attributed to the re-dissolving of the cathode by the solution during the deposit, but did not prove it. The author has investigated the matter experimentally, and confirms Mr. Gray's assumption. Passing the current for three hours through two depositing cells in series, one with a large and the other a small cathode, he found the deposit on the former considerably less than that on the latter. Then, replacing the cathodes in their cells, he noted the loss of weight of each when standing idle for the same time; this loss of weight for each plate, when added to the previous weight of the deposit on each, made the two deposits equal, within the limits of error. In this experiment the solution contained about one per cent. free sulphuric acid. When the plates were left idle in a perfectly neutral solution they gained slightly in weight. By adding to a neutral solution .005 gram of acid per litre, the author obtained a solution in which the plates neither gained nor lost weight when idle, and with which exactly similar deposits were obtained with current densities varying from five to 21 milliamperes per square centimetre. He considers, therefore, that Gray's explanation of the variation is satisfactorily proved.

*** The Hudson River Telephone and Telegraph Company lost about $1,500 in the recent fire on Broadway, Albany.

*** Within a year the first long distance telephone line will be completed to Chicago from New York. The line has already reached Cleveland.

*** New York, Baltimore and Philadelphia insisted on putting the wires underground and now they object to paying the extra expenses incurred, necessarily, in operating circuits in subways with high rental charges.

*** The Union Telephone and Telegraph Company, of New York State, recently elected the following directors for the ensuing year: J. P. Davis, C. J. Glidden, A. B. Uline, D. B. Parker, C. E. Durkee, E. H. Peters, H. L. Storke. The following officers were then chosen: President, Jas. E. Davis; vice-president and general manager, A. B. Uline; secretary and treasurer, Henry L. Storke.

*** A gentleman of Fort Worth, Texas, says: "Extensive improvements in telephone service are contemplated the coming Summer. Plans have been made by the officers of the Southwestern Telegraph and Telephone Company for the construction of a new line of four copper wires to Fort Worth, two to McKinney, two to Sherman and one southward, taking in Waxahatchie and Ennis. From Ennis it is expected to extend the line to Corsicana, bringing the latter city into easy communication with the metropolis. These lines will be arranged mostly in metallic circuits.

*** Mayor Boody, Corporation Counsel Jenks and City Works Commissioner Adams, of Brooklyn, held a conference on the 8th inst., with W. D. Sargent, general manager, and General Wingate, counsel of the New York and New Jersey Telephone Company, the latter desiring to have the old electric subway commission revived. General Wingate made a speech, in which he said he had prepared two bills, one giving the power to the Mayor and the city works commissioner, and the other organizing a single-headed commission. Corporation Counsel Jenks favored a commission, and thought the right policy was to revive the old commission and have the head of it paid a salary by the companies. Neither of the bills presented was approved by the Mayor, who desires another conference.

New Jersey Subway Commissioners.

The New Jersey Legislature passed a bill this session providing for the formation of an Electrical Subway Commission, and Governor Abbett, on the 10th inst., named the following gentlemen: Allan L. McDermott, Miles Ross and James Smith.

The Bi-Telephone Receiver.

BY E. MERCADIER.

This is the outcome of some former papers of the author (see previous abstracts), in which he showed that it was desirable to reduce the diameter of the diaphragm so that its fundamental should be higher than those in the ordinary human voice, and at the same time to reduce the thickness of the diaphragm. Working on these lines, he makes a pair of telephones which weigh only 50 grains (under two ounces), and are only three to four centimetres diameter; these are connected by a loop of spring steel and furnished with soft rubber nozzles which fit into the ears; they can then be worn for hours at a time without the least inconvenience when taking down dictation by telephone. The pattern has been passed by the government telephone bureau as a receiver which is authorized to be used on their lines.

MICROPHONES.

SOME CONDITIONS OF VARIABLE RESISTANCE IN MICROPHONIC CONTACTS.

BY JOHN A. BARRETT, NEW YORK.

Both historically and in usefulness the most interesting and important of all telephone transmitters are those properly classified as microphones.

In all instruments falling within this division, a fundamental and distinctive principle of action is the variation of the resistance of an electric circuit correspondingly with sonorous vibrations, by means of certain over-lapping surfaces of portions of the variable resistance structure, which, through vibratory action, are brought more or less intimately into mutual contact.

An equally fundamental—though not strictly distinctive principle—is that the electric circuit shall not be completely interrupted during the normal operation of the instrument.

The recognition of these two essential requirements alone, without further or deeper inquiry into the subject, is a sufficient basis to enable any one of ordinary ingenuity to produce in endless profusion true and complete microphone transmitters of fair degrees of efficiency.

The first principle, *i. e.*, that embodied in the variable resistance, is the active function of the transmitter; it is that by which alone the operative purpose of the transmitter is effected. The second principle, abiding in the uninterrupted continuity of the circuit, is rather passive, or merely protective, to the action of the instrument.

It is upon the first and no other that the microphone performs its office of transmuting the compound curves of the voice waves into corresponding undulatory electrical pulsations. The second principle limits the action of the first to its normal service, preventing undesirable excursions into a range of action beyond and obnoxious to the intended object, and protecting the result from foreign and extraneous interference.

No one can safely prosecute a study of microphone transmitters, unless with a clear and controlling conception of these two principles in their relation to each other and to the operations of the instrument in which they are embodied.

But within these lie an incidental question of very considerable importance and interest, which appears not to have received any satisfactory discussion; namely: In what manner do surface contacts under vibration produce changes of resistance without interrupting the circuit? Very often the determination of a point within a broader question helps materially to establish correct conclusions; and for this purpose it is the object of the present paper to discuss some of the conditions affecting the variations of resistance in surface contacts.

In Berliner's fundamental microphone patent, it is remarked that the "essential part of the apparatus is the point of contact which *must offer a resistance* to the current." This proposition states the matter with sufficient accuracy with regard to the obvious effect. If the surfaces of two conducting bodies are placed somewhat lightly in contact with each other, a conducting path is established through one body into and through the other body; and this path presents a measurable resistance, which is diminished if the two surfaces in contact are pressed more firmly together, and increased if the pressure is relaxed. Between two bright metallic bodies this resistance of contact is variable from the fraction of one ohm to several thousand ohms, according to the form of the surfaces and the degree of pressure with which they are held together; and in general, it is observable that this variation of resistances depends, for one condition, upon the varying areas of surface, or the number of surface molecules, brought into conducting association with each other.

But it is desirable, in order to elucidate the value of the specific resistance of the contact bodies, to go a step further and distinguish the fact that contact resistance does not lie immediately in the contact surfaces.

Areas of surface can have no resistance. Contact resistance is the resistance of the conducting path, or paths, along which the current converges upon the contact surfaces. Hence, there are several functions entering directly into the variability of contact resistance; chiefly the specific resistance of the contact bodies, and the form, size and arrangement or distribution of the contact surfaces.

It is unnecessary to discuss at length the formerly extant theory of variable resistance of a conductor under variable pressure, beyond remarking that careful tests show that in a homeogeneous conductor there is no such range of variation as would by this means influence perceptibly the action of a transmitter. In all instruments ostensibly acting upon such a theory, the microphone effect is readily traceable to the conditions of surface contact, either between loosely assembled constituent particles of the conductor itself, or between the surface of the mass and another conducting surface.

Without attempting to pursue too far the conditions of contact resistance, nor to produce mathematical formulæ, by means of which the perfect transmitter could immediately be calculated, there are some obvious general principles to be recognized.

Considering only the specific conductivity of the bodies in contact, it is evident that the highest attainable limit of contact resistance will be lower with the best conductors than with conductors of higher specific resistance. In the same instance, also, starting at the outside practicable limit of contact resistance, an increasing pressure will the quickest reduce the resistance to an indistinguishable point; *i.e.*, the range of pressure or of movement within the useful limits of variable resistance will be the least with the best conductor; and, conversely, the higher the specific resistance of the conductors, the greater is the observable range of position and pressure, and the wider the limits of variable resistance.

From this it is apparent that a high degree of specific conductivity in the contact bodies will yield a more sensitive and accurate transmitter in the finer modulations, but will form an instrument of comparatively small range and great liability to disorder; while the power and compass of any given form of transmitter may be increased, within the limits of the mechanical strength of the voice to produce the requisite full range of motion, by increasing the specific resistance of the contact bodies up to a point, where the ratio of contact resistance to total resistance of the transmitter circuit indicates maximum efficiency.

Differences of surface formation, the size, number and quality of the contact areas, and the degree of elasticity of the contact substances, also, must be considered as affecting the length and cross-section of the path, or paths, along which the current passes through the resistance organism under any given conditions of vibration. These differences and their several values may be best studied in connection with certain forms of microphone transmitters in which they are specially emphasized.

In examining the qualities and defects of platinum as a contact material, by means of an instrument specially designed for the purpose, it appears that its specific resistance and its insensibility to oxidation and fusing would give it it an excellent character; but its malleability, which corresponds with lack of elasticity, renders it practically almost entirely unmanageable for the microphone effect. The reason for this is, that the lack of elastic displacement between two surfaces under pressure or impact limits, to an extremely low degree, the range of vibratory movement through which will follow serviceable variations of resistance. It is, however, demonstrable that this is a defect of degree, and not a total lack of qualification. The fact that the resistance of platinum contacts varies to a certain degree under changes of pressure was recognized long before any telephonic use was made of the principle; and it is now known that, with accurately adjusted conditions, a fine platinum needle point resting upon a platinum surface will, within a limited range, faithfully translate undulatory vibrations into corresponding changes of resistance.

In the much-disputed Reis transmitter the first and essential principle of microphonic action is, therefore, in theory at least, surely present, namely: The variability of contact resistance corresponding with the sonorous vibrations. The practical failure of the Reis instrument to transmit speech with uniform success was apparently not due to lack of intention or attempt to produce a speech transmitter, nor to absence of the active speech transmitting principle, but it arose from the failure to perceive and isolate that principle and to employ an effectual protective function, by means of which the variable resistance organism would have been prevented from overdoing its serviceable act, and from introducing foreign and fatal spontaneous sounds.

But while within narrow limits a platinum needle point will transmit speech, the limits will evidently be widened by any modification which introduces a wider range of motion with corresponding variable resistance. Broadening the contact surfaces, employing a plurality of mechanically independent contact points, introducing some form of rocking spring action to supplement the molecular elasticity of the contact surface, will, if properly managed, improve the speaking qualities of the instrument. The end of a platinum wire of No. 20 A. W. G., slightly convex and polished, resting upon a smooth platinum surface, will, under proper precautions, transmit speech with distinctness and uniformity, while a comparatively superior result is secured by employing two platinum plates an inch square in contact with each other. A further increase in the compass of the transmitter is acquired, if between two such inch square plates an extremely thin square of platinum foil of the same size is placed. As to the quality of the platinum contact surfaces, the delicate grain left by the finest emery paper appears to be more effective under most conditions, than either a burnished surface, or the deeper furroughs left by the file or coarser emery.

Another line of improved effects may be added to platinum contacts by introducing the element of molecular elasticity into the contact bodies. Platinized steel gives a wider range of variable contact resistance than solid platinum, and an ivory anvil behind a piece of platinum foil makes the surface contact more susceptible of considerable variations, than would a backing of a less elastic material.

The object of stating these propositions somewhat in detail, with respect to platinum contacts, is neither to introduce at this point a discussion of the Reis transmitter, nor to lead up to the description of a serviceable platinum contact microphone. But the purpose is merely to illustrate by this means some aspects of the characteristics desirable in the contact material, and to enable the superiority of carbon in certain respects to be more clearly distinguished.

Gas carbon or its equivalent fulfills, to an admirable degree, the qualifications required in the microphone contact substances. In resistance to oxidation and fusing it is superior to platinum, in specific electrical resistance it is equally valuable, while its gritty structure gives to its natural surface a suitable and permanent grain, and its high elasticity supplies a wide range of molecular mobility under successively increasing and diminishing pressures, and a great compass of variations corresponding with the vocal vibrations.

The important office of elasticity in the anvil body of microphones of the Blake type is emphatically illustrated in the fact that where carbon is employed as the substance against which the vibratory impacts are received, the perceptible vibration of the mass forming the anvil is much less than that of the diaphragm by which the impulses are communicated, nor is the anvil body considerably displaced from its normal position. The successive pushes and retreats of the vibrating body are received and accommodated and returned by the elastic displacement of the molecules near the point of contact, while the inertia of its mass holds the anvil body nearly unmoved.

On the other hand, if a comparatively inelastic substance like platinum be substituted in the anvil, either the whole mass of this body performs excursions closely corresponding with the vibratory body, or when the rapidity of movement is obstructed by the inertia of the anvil, the entire mass of that body must be displaced and a series of alternating concussions and separations takes place between it and the vibrating body. So that while the weight and inertia of the elastic anvil mass in the Blake microphone are an important addition to its efficiency, the same elements, lacking the elasticity, operate against the transmission of speech. It is frequently observable, also, that in the instance of two transmitters, evidently equivalent in other respects, a difference in their powers is directly traceable to a corresponding difference in the elastic quality of the carbon contact bodies.

This element of elasticity, therefore, should be uppermost in the design of all microphones—whether of carbon or other substituted material—which follow distinctively the Blake hammer-and-anvil type. If carbon is employed, the best results will un-

doubtedly be obtained from the selection of a dense, even-grained, elastic structure, having a surface not too rough and sandy, but rather as smooth as the granular nature of the substance admits.

Following still further a study of this elementary type of microphone, namely: that in which a vibrating hammer thrusts against a more or less elastic anvil, a very important consideration arises in the means to be employed for applying, as efficiently as possible, the full energy of the vocal impulses. These impulses are first to be collected upon a diaphragm, and then transferred to the contact bodies. In the Blake microphone it is attempted to concentrate the vibrations upon the center of the diaphragm, and to utilize their force through the channel of a single opposing contact. Not taking account of the defects of the mouthpiece of this instrument, there are two causes which limit the power of the Blake transmitter: first, the limited contact area and the limited elasticity of the single carbon body, upon which the variable contact chiefly depends, incapacitates this organism for utilizing the full concentrated power of the voice; and second, the disposition of the diaphragm is such that much of the vocal force, which is supposed to be concentrated upon its center, is, in fact, dissipated to other points. Both of these are demonstrable by a convenient method.

It is evident that a plurality of contacts should have a greater capacity for variation than a single contact. Now, a series of Blake contacts, mounted one behind the other, so that the combined bearing is upon the one middle point, does not materially increase the power of the transmitter, unless special means are at the same time devised to apply and hold an increased vocal energy upon that point.

The pressure of a contact upon a single point tends to deflect the vibrations to comparatively free portions of the diaphragm. But if a plurality of similar contacts be distributed separately over the area of the diaphragm, the character and location and adjustment of the contacts being judiciously arranged, and the sonorous vibrations not being concentrated upon any point, but properly diffused over the operative area, the compass of the transmitter is proportionately enlarged.

It may be inferred, then, that having determined the phonic capacity of any individual pair of contact bodies, of whatever form or material they may be, or however limited in range, the compass of any transmitter could be increased to a serviceable degree, by dividing the voice energy by the capacity of a single contact, and apportioning the vibrations amongst the indicated number of contacts.

This is found to be approximately true in general, and it may be readily observed in the case of platinum contacts. The practical defect in the microphonic action of platinum contacts is one not of kind but of degree, and a multiplicity of such contacts, by adding together into an appreciable aggregate a number of separately almost imperceptible units, demonstrate, *a postiori*, the entity and positive mathematical value of each single unit.

The great majority of microphone forms may be referred directly to this simple hammer-and-anvil type. But an important subdivision includes instruments which introduce certain new features, though no new essential principles. This subdivision is well represented by the Hunnings granular carbon transmitter. In this type of microphone, instead of a determined form and number of contact bodies in methodical arrangement, an indefinite number of fine grains of carbon, of irregular shape but approximately uniform size, are heaped together in a containing vessel. This collection of loose grains is so acted upon by the sonorous vibrations as to be successively compacted and loosened correspondingly with the character and amplitude of the sound waves. The resulting variations of electrical resistance are of wide range and great delicacy.

In the Hunnings transmitter the carbon particles lie between a thin metallic diaphragm, preferably of platinum, and a solid metallic anvil or resisting wall, against which they are compressed by an upward or inward thrust of the diaphragm. The electrical path is from the diaphragm through the carbon particles into the anvil. There is evidently here a somewhat complex multiple series of contacts: first, between the diaphragm and the carbon grains, then between the several carbon particles amongst themselves, and finally between the carbon grains and the anvil; but the analogy between each individual contact and the single contact type of microphone is plainly apparent, and it is equally easy to observe the important function of elasticity in the carbon particles.

The theoretical superiority of the granular carbon transmitter exists undoubtedly in the distribution of the voice energy over nearly the whole diaphragm, and amongst a large number of contacts, so that the amount of work to be delivered through any given point lies well within the capacity of the elements through which it passes. From this arise the high efficiency, compass and accuracy of the instrument under the varied conditions of speech transmission.

There still remains a quality of microphonic action to be discussed, together with the causes which probably most influence it; namely, the accuracy with which the complex undulatory curves, representing the original vocal sounds, are reproduced in electric waves. It is evident to an observer that the correspondence is not exact. The voice of the speaker is more or less changed through the medium of the microphone. Individual instruments differ unaccountably in this respect. But the effect of decided alterations in form and adjustment of transmitters will lead to some propositions as to the causes which detract from an accurate transfer of the voice.

Leaving out of account the influence of self-induction in the circuit, and other conditions extraneous to the microphone, the perfect instrument would vary the electrical resistance at every stage in exact equivalence with the force of the sonorous vibrations. In the usual form of transmitters the voice is received upon one face of the diaphragm, and the resistance contact rests against the opposite face. The inward motion of the diaphragm is consequently impeded, and the outward motion is assisted; introducing at once a tendency to alter the slope of the curves, by lengthening the abscissa of the inward movement, and shortening that of the return. This effect would be very considerable with a slender diaphragm and large amplitude of vibration. It would probably be the least in a thickened diaphragm, against which the resistance structure were firmly supported in such a manner that the actual physical movement of the diaphragm is reduced to a minimum, and the vibratory energy is transformed chiefly into variations of static pressure. But even under such conditions the pressure and the corresponding electric wave will, no doubt, decrease more rapidly than it will increase, and some degree of distortion in the form of the undulatory curves will be produced.

The next cause for disagreement between the actuating voice and the resultant electric fluctuations is the practical impossibility of manufacturing microphone contacts which will produce a variation of resistance exactly corresponding with changes of pressure.

It might be possible by accident, or by great labor, to secure a pair of contacts possessing such conditions of elasticity and form that, within narrow limits, the two changes would agree closely. But over a wider range a discrepancy would certainly appear, and it would be impracticable to repeat the conditions in any considerable number of instances. It is probable, however, that with a multitude of small contact bodies, in the lower stages of pressure, and within comparatively narrow limits of variation, the average correspondence is much closer than with heavier bodies and larger differences of pressure.

These propositions are consistent with what may be observed in certain distinctive forms of microphones. In the single contact instrument typified by the Blake transmitter the range of diaphragm motion is at a maximum. In a large number of these transmitters where the voice is nearly as strong as the contact can manage, that is, when the limits of variation are wide, the quality and timbre of the voice are completely altered. The same instrument may possibly be adjusted so that with a milder and more delicate voice, the limits of contact variation being narrower and the pressure in the lower stages, the quality of the voice will be reproduced with astonishing accuracy. There are some Blake transmitters, accidental individuals, which appear to possess both range and accuracy beyond any assignable reason.

One of the best microphones which has ever been devised, having regard chiefly to the accuracy with which the characteristics of the voice are copied, is that one of Edison's numerous modifications in which a broad-faced disk of compressed lamp-black is employed in contact with a corresponding plate of hard carbon. Notwithstanding the common theory that the action of this instrument is due to supposed variations in the resistance of carbon under changing pressure, carefully applied tests appear to indicate that the variations of resistance, by means of which the transmitter is operative, are due to changes of surface contact between the hard carbon and the lamp-black buttons. Whatever variations occur within the body of lamp-black proceed from loose contacts between particles of the substance, which have not been thoroughly compacted together. The principle of action consequently introduces nothing essentially new in microphone effects. But with respect to its superior accuracy of transmission, there are two features observable in this instrument. The diaphragm possesses comparatively small amplitude of motion, being dampened by the firm pressure of the broad surfaced contacts. The sonorous vibrations are consequently converted mainly into variations of pressure, with a minimum change of position of the several parts of the apparatus. The microphonic action also takes place between a multitude of small contact points presented by the peculiar surface formation of two contact bodies, and these minor contacts are distributed over an active field of considerable area.

The Edison transmitter, however, has never been found to be of great practical utility; the delicacy of the adjustment required, and the closeness with which the mouth must be applied to the instrument for securing its best conduct, rendering it generally unsatisfactory in service.

The superiority of the Hunnings type of transmitter is apparent in this connection from its combining the widest compass, and a universal and always ready adaptability to working conditions, and freedom from required adjustments, together with a fair degree of accuracy in its copy of the voice. The large vibratory excursions of its diaphragm and the impeded inward motion are, no doubt, chiefly instrumental in imparting a certain noticeable hoarseness to its ordinary vocalization. A thickening of the diaphragm and a closer packing of the carbon grains reduce the power of the transmitter, but improve its vocal quality. At the same time it is to be noticed that power, and compass, and distinctness, are worth gaining at the expense, if necessary, of some degree of faithfulness to the quality and finer modulations of the initial voice. It is possible, in fact, that a certain jerkiness of microphonic action, with a tendency to progressive motion in minute straight lines and obtuse angles, is well adapted to offset the leveling and rounding disposition of the electric and magnetic conditions, through which the impulses pass to the stage where the audible sounds are rehabilitated; and it is too much to expect that, together with the accomplishment of more essential objects, all the disturbing influences of transmission should either be removed or counter-balanced so completely, that a perfect synthesis of the actuating voice shall be produced at the receiving station.

Reinforced Cylinder Presses.

The accompanying cut shows the very superior press manufactured by Messrs. Watson & Stillman, of 210 East Forty-third street, New York city. This press is specially designed for pressing fibre used in electrical trimmings. The beam acting strain on the cylinder is taken up by reinforcements of the body of the cylinder and not by a separate yoke. On account of the motion being too great to allow the ram to

REINFORCED CYLINDER PRESS.—WATSON & STILLMAN, NEW YORK.

be taken out for repacking the cylinder, without taking down the press, the packing is placed underneath a gland. Small downward acting automatic cylinders, of 12 tons power, are placed on each side of the press and force the ram back very quickly and steadily, also clear the dies, which may happen to be in the press, if they should stick together. This cylinder and ram attachment may be placed on any of the company's presses, if desired.

TELEGRAPHIC

.... The new telegraph line from South Florida is kept very busy.

.... Burglars entered the Western Union Telegraph office in Middletown, Conn., lately, and robbed the money drawer.

.... The United States Fish Commission steamer "Albatross" is at present engaged upon the work of making a preliminary survey for the proposed submarine cable from San Francisco to the Hawaiian Islands. The present survey is the third in the series, and is from Point Conception to Hilo.

.... The question as to the right of the Western Union Telegraph Company to build a line along the Lake Shore road to Woolley will be decided in the United States District Court shortly. When the Pacific Postal secured the restraining order from the Superior Court of Snohomish, requiring the Lake Shore Company not to allow the Western Union to build along its right-of-way, the Western Union ignored it. A new restraining order was then obtained against the Western Union, requiring it to discontinue work and was obeyed. The Western Union intervened in the case against the Lake Shore and has secured the transference of both cases to the United States Court. The hearing of an application for a temporary injunction will therefore come before Judge Hanford this morning, and if the injunction is refused the restraining order will, *ipso facto*, expire and work can then continue.

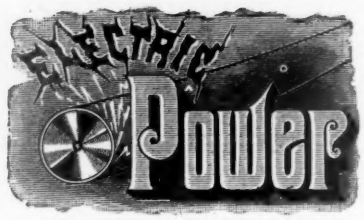
Government Postal Telegraph.

A bill was introduced in the United States Senate on the 7th inst., by Mr. Sawyer, chairman of the Committee on Post Offices and Post Roads, to establish a postal telegraph service. It authorizes the Postmaster-General to contract with owners of telegraph lines to transmit dispatches and money orders in connection with post offices at charges not exceeding existing rates. No additional officers or positions are created nor is any expense over and above the receipts for the transmission and delivery of such messages to be incurred. The Postmaster-General may conclude conventions with other nations to extend this service to foreign countries.

Accumulators for Telegraph Work.

BY C. GRAWINKEL.

This refers to the use of accumulators at the Berlin general post office, the experiments in which began in 1885, and which are now working most satisfactorily. About 300 circuits are worked from one battery of 80 cells, and careful measurements show that for open circuit working each line requires somewhat less than 24 milliampere hours per day. For closed circuit work about 300 milliampere hours is required per line; but these circuits, being mostly low electromotive force ones, it is found more convenient to keep separate and work off a few cells of their own. Even when working with Tudor lighting batteries (52 A. H.) there was a saving of 33 per cent. over Daniells, and this allowing 20 per cent. depreciation of accumulators, and the same supervision as for the copper cells, as the accumulators were of the ordinary lighting type, and were watched with the utmost and constant care. The form now adopted is a single positive between two negatives hanging from an insulating lid in a glass cell. The plates are 9 centimetres x 15 centimetres x 4 millimetres thick ($3\frac{1}{2}$ x 6 x $\frac{5}{32}$ inches); the glasses 21 x 13 x 4.5 centimetres broad; the plates are 11 millimetres apart. The author again refers to the economy and other advantages of using such cells as these, kept constantly charging off a set of Daniells, for heavy work of all kinds and especially for cables; it is, of course, much more expensive than charging off the town lighting mains, but generally cheaper than putting down a dynamo and engine, or working off a large number of Daniells direct.



* * The receiver of the Coast Line Railroad, of Georgia, will substitute electricity for the present motive power, provided, the necessary funds can be secured.

* * Mayor Latrobe, of Baltimore, recently signed the ordinance authorizing the Central Passenger Railway of that city to use electricity as a motive power instead of horses.

* * The Monumental Mills Company, Housatonic, Conn., is building a mammoth dam across the Housatonic river, a few miles above the town named. It is given out that the company is going to put in an electric plant, generating power there and transmitting the same to its mills.

* * Articles incorporating the Fond du Lac Electric Company, with a capital stock of $100,000, were filed March 4. The company is formed to buy the franchise of the defunct Fond du Lac Street Railway Company and operate an electric railroad, and will also equip an incandescent light plant and furnish power.

* * A concern called the Framingham Power Company has been organized with a capital of $10,000, and will soon erect a large building in South Framingham, Mass., where power will be furnished any companies desiring it at a nominal rate. The company will be incorporated under the laws of Massachusetts. It is officered as follows: President, G. E. Cutler; treasurer, S. H. Williams; clerk, Richard L. Everit.

* * The government is deepening the channel of the Mississippi river at Rock Island, Ill., where the arsenal is located, and the rock in the river bed has been drilled by electric machinery quite similar in design and principle to the drills that are driven by steam or compressed air. The particular portion of the work on which electricity was employed is a strip of limestone rock about 600 feet long and of an average width of 50 feet. The remainder of the rock is a much softer sandstone and can be profitably drilled by hand. It has been shown, however, that electric power only costs about half as much as hand drilling in the harder rock. Nine drills were used on the work. Eight of these were mounted on weighted tripods in the usual manner, while one, somewhat larger in size, was mounted on a carriage and wheeled about on a temporary track. Current was obtained from a generating plant installed in a temporary power-house erected on the island.

To Equip With Electricity.

Permission has been granted the Springfield, Mass., Street Railway Company to extend its line in West Springfield and to equip with electricity, under several conditions, among them the following: That the feed wire be placed underground when ordered by the selectmen, and be properly insulated; that the fire department may cut the wires when necessary in case of fire, when the company shall also cut off its current if required, and that in such a case, or when broken by employés of the town, the wires shall be mended at the company's expense; that the company grade the streets through which it runs to conform to its tracks, and that it widen and harden with six inches of good gravel these streets, subject to the acceptance of the selectmen, not to exceed 38 feet from shoulder to shoulder; that the company pave the space between the rails with material satisfactory to the board, and that it repair the floor of the North End bridge between its inside track and the north edge of the bridge when necessary; that the work of construction, material, repairs, care and rails used be satisfactory to the selectmen, that the shape, wood and quality of the poles, and the color they were painted, be satisfactory to the selectmen, and that none shall be erected until approved by the board; that the track be finished by January, 1893.

Important Valve Improvement.

The conditions to which stop-valves are subject, and that tend to impair their efficiency, have not all been provided for in existing valves. New valves, though well tested when made, often fail to be tight when put in service. A leaky valve soon works its own destruction. The joint's position in the body does not admit of noting the condition of the valve when in service. The condition of the valve when operated indicates only the success or failure in making a joint. Should it fail and leak, the application of a lever or wrench to the valve handle is usually resorted to, and a collapsed seat, bent stem, bulged disc or strained body, are the common results of such practice. New and old pipe systems contain sand, scale, grit, borings and other substances that are trapped in the valve body, and lodge on the surface of the seat. This is one of the prime causes of valve injury and may happen at any time to the ordinary patent composition seat valve. The end and side thrusts or force used in fitting the screwed or flanged ends of the valve body, will often distort the face of the seat and cause it to be out of true. The ordinary commercial stop-valve has not sufficient strength in its parts to resist the usual strains that it is subject to in general practice, and such valves, even when first applied, are unfit for service in some locations. What is evidently wanted is a seat that will not be injured by the ordinary force of a wrench applied to the valve-handle, and which will afterward be efficient when operated in the usual manner.

The above defects are said to be entirely overcome in the "Roy Valve," which also possesses numerous original features peculiar to this valve alone. The ELECTRICAL REVIEW is pleased to present the claims of the manufacturer in full, as follows:

It contains a method of making a joint that is a radical departure from the usual manner of joint making in a valve body, and assures a tight joint under conditions in which other valves fail. It makes a simple metallic joint which combines the essential features of a ball and socket, and of the well-known expanded joint, such as is used on boiler tubes in heads.

It is simply a jointless ring of expansive material, inserted in the body, and is as simple in application as a washer. Any kind of malleable material is used, such as copper for steam, iron for ammonia, lead alloys of different kinds for water, etc.

The ring rests on a conical base and its action to compensate for distortion of the joint is as follows:

The ring resting on a conical base will make contact on its entire inner edge, if both ring and base are true. If the base be distorted, the ring will touch on two or more spots, depending on the degree and nature of the distortion. When a pressure is put on the upper edge of the ring by means of a flat disc, the ring is forced outward by the prominent points on the conical base, and drawn inward to fill the depressions. The plane of the top surface of the ring remains undisturbed, but free to move laterally on the face of the disc. It is obvious that an extraordinary degree of distortion is provided for.

The method of inserting the ring is as follows: The annealed or soft ring is placed in the recess intended for its reception in the valve body. The bonnet is then screwed down in the usual manner, and the spindle operated to close the valve. The ring coming in contact with the disc is resisted in its passage to the lower part of the recess by the conical base, which causes the ring to permanently expand its lower edge, thereby locking it under the outer wall of the recess. As the circumference of the base of the recess is greater than its entrance, it follows that the ring will assume a degree of expansion similar to the base of the cone, and the elasticity of the ring in combination with the conical base of the valve with the flat disc, will compensate for the usual distortion met with in practice.

The application of the ring is quickly made, and its removal, if injured by scale or grit, is by a pair of pliers or similar means that will collapse the ring to a slight extent inwardly, and thus at once free it from the recess.

Its continuous line on contact affords no outlet for the escape of fluid or gas, as is usual with threaded joints, and will, no doubt, with the other original features of this valve, receive the endorsement of the engineering profession.

The Proposed Electrical Underground Railway for Paris.

BY C. CARRE.

The plan accepted by the municipal council is that of M. Berlier (cf. *Lum. El.*, vol. xxxiii, p. 276). The first section of the projected railway will start from the Bois de Boulogne to the Place de la Concorde, to be subsequently continued, parallel to the river, to the Vincennes terminus, thence to the Ceinture, taking the Lyons terminus on the way; thus roughly bisecting the city on its largest diameter.

On the first section there will be six stations, the generating one being at the outer end of the line. For the subsequent prolongation, there will be a generating station in the middle, near the Place de la Bastille. There will be a single tunnel, 5.8 metres diameter, with two lines of rails, the roof being about two metres below the level of the streets. The tunnel will be an iron tube built up as it progresses. The current will be picked up from a center raised insulated iron rod two inches square, which will be connected to feeders run in a conduit between the two lines; the return is through the rails. It is intended to work at 400 volts, with two 25 horse-power motors on the leading carriage. According to the requirements of different times of day, different services of trains will be used; heavy service trains of five carriages, two minutes between trains and two minutes stops at stations; medium service, two carriages, two minutes interval and one minute stops; and light, two carriages, five minutes interval, one minute stops. The traffic is estimated at about 7,000,000 passengers per year, and it is also intended to use the line for goods traffic at night.

A Big Street Railway Contract.

President J. A. Rhomberg, of the Dubuque Street Railway Company, Dubuque, Iowa, has just closed a contract for the equipment of his entire line with the overhead electric system. This road was equipped with a storage battery system on May 29, 1891, furnished by the Accumulator Company, of Philadelphia, but has never worked successfully and it was finally abandoned entirely on account of the great expense necessary to keep the road in operation. The overhead work, comprising the setting of poles and wires, was given to the Edison Company, who will also furnish the dynamos. J. G. Brill Company, of Philadelphia, and the St. Louis Car Company will furnish the cars necessary in making the change. The Detroit Electrical Works will furnish the equipments for fifteen 30 horse power American standard motors, which Mr. Rhomberg thinks superior to any placed on the market. The testimonial published below speaks volumes for the merits of the Detroit equipment, and the fact that their factory is rushed to its fullest capacity is enough to convince one of its popularity.

Mr. L. E. Myers, representing the Detroit people, and who had charge of this business, is to be congratulated upon having secured this contract notwithstanding so much competition, which waxed so warm that the Dubuque *Times*, of March 7, contained a page article relative to same. Mr. Myers is entitled to much credit for the business-like manner with which he conducted this deal:

SPRINGFIELD, ILL., Feb. 2, 1892.
Detroit Electrical Works, Detroit, Mich.

Gentlemen—In reply to yours of January 28, would say that last Fall, during the State Encampment, most of four weeks, we had three trail cars to each of your motors, and pulled them up a three per cent. grade with perfect ease with from 250 to 300 persons; but with your last improved or inverted motors we had four trailers and brought in, by count, 422 persons without any trouble whatever. We did the same thing during our fair in September last, and if I did not think your motors did the most work with the least power, I should not have given you, lately, an order for five more motors.

On January 18, 1892, we had a very heavy snow-storm here; our cars never stopped making their regular trips, while the City Railway Company, with other equipments, had to quit running at 5 P. M. We have had no trouble in pulling through heavy snow-drifts. We have two Edison motors, but they being out of repair at that time, we could not give them a fair trial to see how they would go through the snow.

Yours very respectfully,
People's Electric Railway Company,
(Signed) J. N. SCHUCK, President.

The New Thomson-Houston Transformer.

The new "Type F" transformer which has been perfected by the Thomson-Houston Company, of Boston, has many novel and useful features and is finding a very large sale. The style of the box is shown in the accompanying cut.

The leading wires for both primary and secondary are at the top, thus making it very convenient in connecting up to circuits.

All fuses having been removed from the transformer, there is no occasion to open it after it has been installed, thus avoiding the exposure of the core during stormy weather. Its location, therefore, need not be an accessible one.

The secondary fuses are to be placed inside the building, at or near the point where the wires enter. The primary fuses are placed in an independent switch and fuse box which connects at the circuit to the transformer and allows the fuse to be placed in the box with the contacts entirely disconnected with the line, thus making it very free from danger when it is necessary to replace fuses. This primary switch and fuse box is furnished with all transformers, and is to be placed in any convenient location which will allow ready inspection and renewal of fuses.

A new and valuable feature is the introduction of oil into the transformers to keep moisture from the insulation, to greatly increase the insulation and to prevent as far as

NEW THOMSON-HOUSTON TRANSFORMER.

possible its destruction by high potential discharges, occasioned by lightning. Immediately after the discharge the oil re-insulates the points at which the discharge may have taken place and renews the insulation, leaving the transformer in perfect working condition.

In the winding of these transformers the very best insulation is used and without oil will stand test of 5,000 volts alternating.

The transformer is believed to be as nearly perfect as it is possible for science and conscientious methods in practice to make it. It has a high insulation to begin with, and by the use of oil the insulation is increased and preserved, so that it stands without an equal on the market to-day.

The Milliken Catalogue.

Milliken Brothers, of 55 Liberty street, New York city, have favored us with a copy of their new catalogue. It is one of the handsomest we have seen this year, and is in keeping with the complete and artistic character of all their work. The Milliken patent poles for electric light, telegraph, telephone and street railway use are too popular to need comment from us. Their large and rapidly increasing business in all classes of iron and steel roofs, bridges and fireproof structures keep their works at Croton, N. Y., up to their full capacity throughout the year. The success of this house is another example of what reliability of product and conservative business methods will do.

The Fall River authorities have decided to permit the use of overhead street railway wires.

Mr. Tesla Before the Royal Institution, London.

Although the official report of Nikola Tesla's lecture before the Royal Institution, London, recently, has not yet been published, our readers would not find a *resumé* uninteresting and we publish an article of this character taken from our esteemed contemporary the *Electrical Engineer*, of London, of a recent issue. Mr. Tesla is the lion in electrical circles without doubt and deserves every honor given him:

The lecture given by Mr. Tesla on Wednesday last week before the Institution of Electrical Engineers, and repeated on Thursday before the Royal Institution, will live long in the imagination of every person in the brilliant scientific audiences that heard him, opening, as it did, to many of them, for the first time, apparently limitless possibilities in the applications and control of electricity. Seldom has there been such a gathering of all the foremost electrical authorities of the day, on the tiptoe of expectation to witness the experiments, details of some of which had already been given to us from the other side of the Atlantic, but of which no written account could convey the true significance and beauty. Long before the hour of meeting the hall was crowded, and Mr. Tesla was watched throughout with the keenest interest as he adjusted his apparatus, quivering with lightning-like discharges, and now lighted a vacuum tube by grasping it in his hand, now brought to incandescence the filament of an ordinary lamp attached by a single wire, there rendering the air in the interior of a large ring luminous with flame, or sending streams of light from wires stretched over the audience, and, most fascinating of all, after electrifying the whole space of air between his table and an iron plate above him, waving a luminous tube in his hand totally unconnected to any wire whatever. It was, indeed, curious to see the most prominent and noted electricians of the day as interested in Mr. Tesla and his experiments as any child with the first friction machine, asking whether it was safe to do this or that, to touch the wires, and whether they might be allowed to try. For full two hours Mr. Tesla kept his audience spellbound, with easy confidence and the most modest manner possible displaying his experiments, and suggesting, one after another, outlooks for the practical application of his researches; and it was difficult to realize that this memorable lecture was the second only that he had ever delivered. Even at the end Mr. Tesla tantalizingly informed his listeners that he had shown them but one-third of what he was prepared to do, and the whole audience, after Professor Ayrton had proposed the vote of congratulation and declared the meeting over, yet remained in their seats, unwilling to disperse, insisting upon more, and Mr. Tesla had to deliver a supplementary lecture.

In the first place, it may be stated, as Mr. Tesla mentioned, but which hardly seems to be realized, that practically the whole of the experiments shown were new, and had never been shown before, and were not merely a repetition of those given in his lecture in America. That of lighting tubes in an electrostatic field and of bringing filaments to incandescence on a single wire were shown before, and being of the most importance, naturally, were not left out. But all the other experiments, together with most of the apparatus itself, was novel, and was supplementary to that of his American lecture.

In the next place, it is important to understand—as also stated by Mr. Tesla at the time, but hardly, perhaps, yet realized—that nearly the whole of his experiments and effects were produced by means of an ordinary alternating current from an ordinary commercial alternating current dynamo—such, in fact, as can, in many places, be obtained from a central supply company's mains. These effects can be, and were, brought about also by means of the currents from his special alternator, but the chief benefit of the use of this alternator is in being able to obtain perfectly harmonious currents of a known number of alternations per second, and in research work this knowledge is evidently of immense value.

Without going deeply into the detail or the theory of the working of the apparatus used, it is seen, therefore, that the effects are produced by using an alternating current, either generated direct at high potential and with high frequency of reversal per second, or ordinary currents converted into such currents. Mr. Tesla termed these currents "alternating currents of high potential and high frequency," but in the same way that the term rotary current (first proposed, we believe, in these columns) has now gained acceptance to indicate alternating currents varying in phase for producing a rotating magnetic field, so we may, perhaps, venture to use the term "vibratory currents" for those of high potential and high frequency. To generate vibratory currents from an ordinary alternating current circuit, Mr. Tesla uses, first, an ordinary transformer in oil to transform upwards; the secondary current from this he passes into a second transformer having in its circuit a magnetic spark interrupter, and from the secondary circuit of this second transformer (which, it may be noted, is of comparatively thick short wire) he obtains discharges in all respects similar to those of the great induction coils, but of very high frequency. Connecting this circuit to a properly adjusted condenser, in his case a set of Leyden jars, a surging effect is produced on the currents, which raises the frequency of vibrations from 25,000 or so per second to some millions per second, and the potential to some hundreds of thousands, or even, perhaps, millions of volts. The frequency in the case of the use of the Tesla dynamo can, of course, be accurately determined. The potential, it seems, cannot be accurately arrived at by calculation, or, rather, the calculation does not give an accurate result correspondent with the actualities achieved in these effects—a fact, as we shall see, that may have very important theoretical results upon the wave theory of electricity.

FIG. 1.—GERMANIA UNIVERSAL SHADE-HOLDER.

Having at command a vibratory current of this nature, the results shown by Mr. Tesla were the first outcome of continued and careful experiments. Not only does the molecular bombardment of the molecules of highly-exhausted gases in vacuum tubes show phosphorescence, but gases at low states of exhaustion do the same, and even ordinary air at ordinary temperature, as Mr. Tesla showed at his lecture, where the space between two concentric rings glowed with discharge like a vacuum tube itself, while the vacuum tube glowed when at some considerable distance from the plates to which the two poles were connected. In this manner, by vibrating the air molecules at speed correspondent to that of the vibration of light, phosphorescent effects could be shown with ease. Phosphorescence, Mr. Tesla explained, he regarded as incandescence in another form. Ordinary incandescence accrues after the filament has passed interiorly from the state of cold to that of intense heat; while, if we regard a bombardment of molecules with sufficient intensity upon the surface of a material, we may conceive an infinitesimal film of that material rendered continuously incandescent without the trouble of heating the whole—in a word, we obtain the light vibrations without passing through the whole gamut of heat vibrations—which has long been the electrical engineer's most ardent desire. To obtain a concrete idea of the difference between the ordinary alternating current and the vibratory current, we might imagine the first as a large ordinary steam engine reciprocating at 100 revolutions, while the second becomes a smaller and smaller material engine as its reciprocations mount from hundreds to thousands, or hundreds of thousands, in the same unit of time. In the latter we have the greatest efficiency with the smallest of first outlay.

FIG. 2.—GERMANIA UNIVERSAL SHADE-HOLDER.

Mr. Tesla incidentally showed that the glow discharge in a tube, under certain conditions, would revolve and then become extremely susceptible to the feeblest magnetism, and he hinted that possibly by this means the rapidity of transmission of telegrams through submarine cables might be greatly increased.

A word remains about one or two personal and scientific problems. In the first place, it will be interesting to know Mr. Tesla's own ideas as to the future practicability of his researches—ideas which, of course, will have to await their fulfillment for some time for actual application in practice. The question naturally arises: How can the vibratory current be applied to lighting? Should we expect to have incandescent or phosphorescent lamps of a pattern similar to those we know in the Edison-Swan lamps or the Geissler tubes, or should we expect rather to discover a practical means for rendering the whole mass of the air in a room softly and beautifully phosphorescent? Both, Mr. Tesla thinks, if we understand him aright, may occur, but he looks certainly to the possibility of the last and most fascinating project.

Further, many of those who witnessed his experiments must have asked themselves a question as to the danger of the vibratory currents, which Mr. Tesla handled so unconcernedly. We took an opportunity of enquiring of Mr. Tesla, with reference to this point, how, indeed, he came to dare to take the current through his body? It was the result of a long debate in his mind, it appears, that caused him to attempt the experiment. Reason and calculation showed him that such currents ought not to be dangerous to life any more than the vibrations of light are dangerous. The self-induction and frequency of alternation should be too great for any current to pass, and for a current to be dangerous a certain quantity must pass. Conceive a thin diaphragm in a water-pipe; with to and fro piston-strokes of considerable amplitude the diaphragm will be ruptured at once. With reduced strokes of the same total energy the diaphragm will be less liable to rupture, until, with a vibratory impulse of many thousands per second, no actual current flows, and the diaphragm is in no danger of rupture. So with the vibratory current—yet in spite of reason and analogy it was with the feelings of a man about to plunge from Brooklyn Bridge (as one might well believe) that Mr. Tesla took his first shock from his apparatus. The result justified his daring, and he suffered no more than a slight shaking in the arms. A spark, of course, passes and this punctures the skin and causes a slight burn, but that is all. This can easily be avoided by holding a conductor of suitable size in the hand and receiving the shock upon that.

There lurks in one sentence of Mr. Tesla's lecture a statement which will cause much discussion in high scientific circles. We shall not further refer to it here than to say, that if the voltage obtained is not exactly calculable from the data laid down of the condenser and the frequencies—if, in a word, the result is not approximately that calculated, but considerably lower, then this would certainly seem to show that Hertz's experiments and results are not final, and the way is open to further experiments and research in this direction.

From the way in which Mr. Tesla alluded feelingly to the impulse in research given to himself from perusal of Crookes' experiments in high vacuum, the effect upon students and scientific men generally of the publication of his own promising researches must be great. We can only hope that others, now that the way has been shown, will take up the work, and before many years have passed produce for the world at large the thoroughly practical outcome hinted at in the "wonderful" lecture by Mr. Tesla at the Royal Institution, on Wednesday, February 3, 1892.

Germania Universal Shade-Holder.

A shade-holder so made that it can be used on varying sizes of lamp sockets has long been in demand, and many efforts have been made to meet the demand, but up to the present time none has been offered that would fill all the requirements.

The principal sockets on the market are the Edison, Thomson-Houston and Westinghouse, and of these the socket shell diameters are of two sizes. The Thomson-Houston and the Westinghouse are of the same size and the Edison is larger, so that two different size clamping devices or rings are necessary to adapt a shade-holder to them.

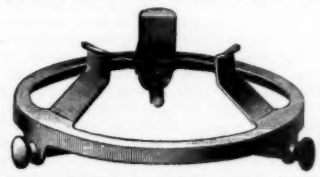


FIG. 3.—GERMANIA UNIVERSAL SHADE-HOLDER.

The Germania Electric Company, of Boston, have solved the problem with their Germania universal shade-holder. Fig. 1 shows this shade-holder as used on the Thomson-Houston the Westinghouse sockets. Figs. 2 and 3 show the method of applying it to the Edison socket. It has no weak points and there are no joints to work loose.

ELECTRIC LIGHT NEWS

—— Chelsea, Mich., will have electric lights.

—— Crestlein, O., will vote on electric lights.

—— Geneva, Ia., is talking of electric lights.

—— Eagle Grove, Ia., is talking up electric lights.

—— Highland, Ala., is investigating electric lighting for its streets.

—— Oil City, Pa., talks of buying and operating its own electric light plant.

—— Cuthbert, Ga., will vote soon on the question of establishing electric lights.

—— Georgetown, Tex., will probably be lighted by electricity in the near future.

—— A company is projected for the purpose of lighting Warwick, N. Y., by electricity.

—— A committee of Bethlehem, N. H., is investigating electric lighting for the streets of that town.

—— The citizens of Oxford, Pa., will vote on the subject of electric street lighting at the next election.

—— Oneonta, N. Y., has called a special election to vote on a proposition to light the streets by electricity.

—— Hawarden, Ia., expects to organize a joint stock company to erect and maintain an electric light plant.

—— An electric light plant will be installed in the State Insane Asylum at Northampton, Mass., during the coming season.

—— The *Illustrated Buffalo Express* gives a very complete history of the Brush Electric Light Company, of that city, in a recent issue.

—— The Hartford Electric Light Company has elected A. C. Dunham, president; E. B. Bennett, vice-president; H. M. Clark, secretary and treasurer, and Thomas Evans, auditor.

—— The Chicago city council has awarded a contract to the Chicago Arc Light and Power Company for 280 street lamps for seven years at 50 cents per lamp per night. These lamps will be placed in districts not now covered by the city's lighting plant.

—— Assistant Corporation Counsel David J. Dean is in Washington. He will argue before the United States Supreme Court, in behalf of the city of New York, the important suit of the electric light companies, which involves the constitutionality of the subway laws. David Leventritt is counsel for the plaintiffs.

The "Ward" Arc Lamp.

This lamp, which is owned by the Electric Construction and Supply Company, New York city, is being received with enthusiastic favor all over the country. Although the "Ward" arc lamp, which is run on incandescent circuits, has been before the electrical field for only a little over two years, many thousands have been installed during that time, and are now being successfully operated. Hundreds, in fact thousands, of these lamps are used in central stations in connection with the incandescent plants. The success with which the Electric Construction and Supply Company is meeting is well deserved and may be accredited to two things—the excellence of the lamp and the energetic and progressive management of President Herbert Torrey and General Manager R. B. Corey. These gentlemen have not hesitated to take advantage of every improvement they could secure, and among their specialties have an electric railway lamp which is coming into very extensive use among the electric railways of this and other countries.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. Chas. W. Bassett, connected with the insulated wire department of the Washburn & Moen Company, favored this office with a visit recently.

Mr. Chas. W. Holden, president of the American Casualty Insurance Company, No. 30 Congress street, this city, has liberally distributed among the various trades a useful memorandum calendar.

Fitchburg, Mass., capitalists will soon organize an electric power company, and a motor power circuit, in the city named, will be installed at an early day.

The Simplex Electrical Company recently received several large orders representing many miles of heavy feeder wire—T. Z. R. insulation—for electric railway use.

Electric Propulsion Successful Against Snow Storms.—During the heavy storms which have prevailed in and near this city recently, the electric cars made uninterrupted trips.

Electric Railway Extension.—Permission has been granted the Lowell and Suburban Railway Company to extend its electric system to Chelmsford, Mass. It is said that the double trolley will be used.

The American Bell Telephone Company is reported to have made a net gain of 2,861 instruments during the four weeks ending February 20, and the company now has 515,368 instruments in daily use.

Messrs. L. S. Graves & Son, the well known manufacturers, Rochester, N. Y., has been incorporated as the Graves Elevator Company—under laws of the State of New York—with a capital of $400,000.

Manager Fred. P. Barnes, of the New England department of Westinghouse Electric Company, reports recent installation of his company's alternating system (750 lights) at the station of the Walton (N. Y.) Electric Light Company.

The National Telephone Manufacturing Company, this city, has been successful in having introduced its short line telephone system throughout New England, and have received many testimonials as to the satisfactory service rendered.

Mr. Norman Marshall has shaken the dust of the Quaker city from his shoes and returned to this city, his former field of labor. Mr. Marshall has sold out his interest in the Electric Manufacturing Company and he will soon embark in a new electrical enterprise in or near this city.

Messrs. A. H. Hews & Company, North Cambridge, Mass., have introduced the Westinghouse alternating system in their pottery. The plant was completed recently and is now ready to start up. The lighting capacity of the plant is 150 incandescents; which will be increased in number later.

The American Circular Loom Company, this city, is sending to electric light stations, a neat sample card showing pieces of old wire, before and after being insulated with the celebrated "Canvas Jacket" covering. This company is receiving large orders for its new flexible tubing for interior wiring.

Mr. J. Bradford Sargent, of this city, the New England agent of the C. & G. Cooper Company, Mt. Vernon, Ohio, reports having closed a contract recently with the Worcester, Leinster and Spencer Street Railway Company for the installation of an additional 500 horse-power compound condensing engine.

Petition for Electric Power.—The North Woburn and East Weymouth railway companies, of Woburn, Mass., have petitioned the Board of Aldermen of the city named for permission to apply electric propulsion to their cars. If the permission is granted within a few days, electric cars will be running between Woburn, Melrose Highlands and Stoneham, Mass., by July 1.

The Westinghouse Electric Company, through its New England department, recently sold to the Brookline, Mass., Gas Company two of its latest improved alternating machines of 1,000 lights (incandescent) capacity each. This makes three machines in all of the Westinghouse type installed, aggregating a total lighting capacity of 3,000, which will be ready to start up in the Brookline Company's New Station about the first week in March.

The Shipman Engine Company, No. 197 Summer street, this city, reports recent sales of 35 of its engines during the past month to the following persons: O. Sheldon & Company, Boston; Charles F. Pidgeon, Boston; J. R. Jones, Wiscassett, Me.; John W. Crowley, Niantic, Conn.; W. A. Moxey, Portland, Me; George M. Barrow, Antrim, N. H.; Barre Publishing Company, Barre, Vt.; Theodore Krale, Windsor Locks, Conn.; Appolas Fuller, Suffield, Conn.; F. C. and A. E. Rowland, New Haven, Conn.; J. M. del Valle, New York city; T. H. Truscott & Son, Grand Rapids, Mich.; Pope Manufacturing Company, Chicago, Ill.; Charles C. Kramer, Schoharie, N. Y.; F. P. Lazo, Key West, Fla., and Spanish-American Mercantile Agency, St. Louis, Mo. Already this month one concern has placed an order for three Shipman engines, which probably will soon be followed by a contract with the Shipman Engine Company for 35 to 50 engines per year. W. I. B.

Boston, March 12.

OUR AKRON LETTER.

The Municipal Lighting Plant at Ashtabula is about complete and will be started within a few days.

The Groves Electrical Company are to furnish the lighting machinery for the new Cleveland Theatre.

The Thomson Watt-meters have been installed and a meter rate established for lighting at Akron. The rate is to be 14 cents per 1,000.

The East Liverpool Western Electric Company has just added a 1,300 light Thomson-Houston alternating dynamo and are to start a day circuit and once.

The New Philadelphia and Canal Dover Street Railway has recently installed an alternating current dynamo of 650 light capacity and are supplying lights now in both towns.

Messrs. Lynch & Lyman, of the Canton and Massillon Street Railway Company and the Canton Electric Light and Power Company, were guests at the Buffalo Convention, and were looking up the supply business.

The Akron Electric Company have increased their capacity by a new 50 light Thomson-Houston arc machine and a new 250 horse-power Armington & Sims engine. Two Sterling boilers of 200 horse-power each have also been added.

The New Town of Barberton, O., has some of the nicest lighted streets in the country. The poles are 120 feet apart and carry three 16 candle-power lamps each. The town is the home of the Sterling Boiler Company and a number of other important manufacturing industries. A Thomson-Houston plant supplies current for the street lights. F. H. B.

Akron, O., March 12.

OUR LONDON LETTER.

Gibraltar and Malta.—Some time since Dr. W. H. Preece, F. R. S., was commissioned to report on the electric lighting of Gibraltar and Malta for the government. In regard to the former the lighting has now been determined upon.

Messrs. Laing, Wharton & Down, Limited, Correction.—In a late letter of mine I made the mistake of stating that the head offices of the above company had been removed from 82a New Bond Street, London, W. It was only an outcome of this parent company that had started special offices on its own account.

Train Lighting on South Eastern Railway.—Last week an experimental train, with new American buffet and drawing-room cars, was run from London to Dover. The cars are most luxuriously fitted and have all the latest improvements, including the electric light. It is understood they will be run in connection with the continental service.

The Bahama's New Cable.—On the 4th inst., the W. T. Hawley's Telegraph Works Company completed the laying of a cable between the Bahamas and Jupiter Inlet, on the coast of Florida. The act for construction was passed last session, and the contract for the manufacture and laying down of the cable given to the company, whose cable ship, "Westmeath," left England the end of December last. The termination of the work was in every way successful, and congratulatory messages passed between the company and Sir Ambrose Shea, the Governor of the Bahamas, expressing hope of the usefulness of the cable in binding the colony and the mother country in close bonds of commercial intercourse and affection. The return message ran: "Cable worked splendidly. Contract most faithfully performed."

Sir William Siemen's Electrical Laboratory.—Yesterday afternoon at Kings College, London, Sir William Thomson, the President of the Royal Society, presented to the council, acting for Lady Siemens, the laboratory of electrical engineering as a gift to the college in memory of her late husband, Sir William Siemens, and to record his many valuable discoveries in electrical science. The laboratory contains steam engine and boiler, direct and alternate current dynamos of latest design, large resistances, and complete equipment of instruments, all of the newest construction. There are a number of accumulators and the students can study every branch of electrical engineering. To the special courses of lectures and electrical laboratory work students are admitted after passing two preliminary years in the college engineering department, or on production of certificates of proficiency in physics, chemistry and mathematics. Prof. John Hopkinson, F. R. S., has charge of the laboratory. Sir William Thomson, in making the presentation, dwelt briefly on the past achievements of electrical science, and observed that a completely fitted laboratory like this could not but fail to produce still greater scientific results in the future. Electrical science, that young creature of the nineteenth century, could already hold its own with all branches of engineering in the world, and he believed they were only on the eve of greater achievements. With the gift is included a bust of Sir William Siemens.

CHARLES FFRENCH.

London, February 27.

OUR CHICAGO LETTER.

Mr. Fred. Degenhardt has recovered sufficiently from his recent illness to resume duties at his office again.

The Town Council of Crawfordsville, Ind., spent part of last week in Chicago looking after additional supplies for their plant.

The Street Lighting Plant at Elmhurst, Ill., is now being installed by the Brush Electric Company. One feature of this installation is the neat street fixture designed and built by George Cutter.

W. Worth Bean, president St. Joseph and Benton Harbor Electric Railway and Light Company, St. Joseph, Mich., was in Chicago recently. His company is to equip its entire road with electricity and Mr. Bean has closed a contract with the Thomson-Houston Company for 12 motors and two generators of 110 horse-power each and has purchased six new cars from the J. G. Brill Company. The road will be in operation not later than June 1.

Mr. A. H. Englund, formerly secretary and treasurer of the Electric Merchandise Company, Chicago, has opened an office at 435 The Rookery, as secretary and manager of the International Register Company. This company has purchased the Pratt patents on conductors' fare registers and have equipped a very complete factory for the manufacturing of these machines in both portable and stationary forms. Mr. Englund's long and practical experience in the street railway supply trade has made him a host of friends and the success of his new enterprise is assured.

The Central Electric Company, in preparing for the coming Spring business, have laid in a large stock of all classes of supplies, such as hard rubber tubing, Banner waterproof wire, Bryant sockets, switches and cut-outs, expanding wire guards, Swan lamps and Washington carbons. This company also report being well equipped to handle all orders for carbons of all standard sizes, having a large stock of the moulded, both plain and coated, made by the Washington Carbon Company, for whom they are the general Western agents. M. J. B.

Chicago, March 12.

OUR SAN FRANCISCO LETTER.

The City Council of Santa Cruz recently granted a franchise to the Santa Cruz, Garfield Park and Capitola Electric Railway to run a branch line to the site of the new Union depot.

A Home Company in the city of Pomona, Southern California, have commenced stringing wires and placing lamps for an electric light plant. The dynamos will be situated 13 miles from the city and run by water power.

The Consolidated Electric Railway Company, of Oakland, will commence, at an early date, to construct a cross-town line from the Sixteenth street depot, via Sixteenth street to Center, and thence to Twenty-third avenue. This company has just completed a line from Grove and Fortieth streets to Mountain View Cemetery.

The Messenger Boys of the San Francisco District Messenger Company recently went on a strike, the cause of which was the issuing of an order by the company making it compulsory for all messengers to have tickets properly signed before delivering, and also to have customers, when sending a messenger, place upon the card his destination. The boys claimed that this caused unnecessary delay, as they were often sent to places where the occupants would purposely delay them.

The North Beach and Mission Railway Company, of this city, will now be able to go ahead with their Folsom street electric road. Since the company first applied for a franchise to operate an electric road they have been strenuously opposed on every hand, and not until the Board of Supervisors recently exempted them from the order forbidding the use of the overhead system, so far as their lines on Folsom and Bryant streets are concerned, has their way been free from impediments. It is believed the Thomson-Houston system will be used.

It Can Now be authentically stated that the cities of Oakland and Alameda will be connected by an electric railway. These two cities are situated across the bay from San Francisco, and although separated from one another by b t a few miles, the means of rapid communication between the two places have been very inadequate. Theodor Meetz, who for a number of years past has maintained a one horse car line between the two cities, now states that owing to the demands of the public he will commence at once to construct an electric road. The Edison system will be used, the power to be furnished by an electric light and power company of Oakland. The road is to cross the new government bridge spanning the tidal canal, which latter is not as yet completed.

San Francisco, March 2. J. R. K.

LITERARY.

The March number of *The Ladies' Home Journal* preserves most admirably the excellence which this popular magazine has accustomed its 700,000 readers to expect; the place of honor is given to the interesting and beautifully illustrated article by Ada Chester Bond, entitled, "A Royal Recluse," which deals with the life of seclusion led by the ex-Empress Eugenie at Farnborough, England.

Scribner's Magazine for March contains many noteworthy contributions. The opening pages have the widely announced last poem written by the late James Russell Lowell, entitled, "On a Bust or General Grant," which is in the vein of Mr. Lowell's highest patriotism, ranking with the famous "Commemoration Ode."

The March number of *St. Nicholas* contains a novel and useful sketch by John M. Ellicott, of the navy, describing how a landing is made through the heavy surf of the Pacific Ocean. Boy readers may here learn how to avoid the dangers of an upset when caught in a small boat during a squall. The article is illustrated by Taber from photographs, one of them showing the sailors after an upturning of their surf boat.

The March *Century* is particularly interesting to the many thousands who have constituted the audiences of the famous Polish pianist, Paderewski, in different parts of the United States. These papers on Paderewski are parts of the musical series which *The Century* is publishing this year. The frontispiece is an engraving of Paderewski from a photograph, and in addition a drawing by Irving R. Wiles is given, showing the great virtuoso at the piano.

The *North American Review* for March is vital with thought and suggestions on affairs of moment by men high in the counsels of the nation. Thus, in "The Issues of the Presidential Campaign," the principles upon which the two great parties will go before the nation in the coming Presidential election are outlined, with a precision and authority that in a manner anticipates the conventions, by Senator Hiscock, Representative Benton F. McMillin, Senator Hale, Representative W. C. B. Breckenridge, Governor Merriam, Senator McMillan and Representative Bland.

Queen & Company's Testing Sets.

We are informed by Queen & Company, of Philadelphia, that their portable testing resistance sets still meet with great favor wherever they are introduced. The new style known as the "1891" type, which was brought out last Fall, is especially appreciated as its peculiar construction has overcome many previous difficulties in both outside and inside testing.

As is well known great trouble has been experienced with the galvanometers usually supplied for such work, those with fibre suspension being too delicate for street use, or where running machinery jars the station, and those moving on a central point being too sluggish.

To overcome these defects Queen & Company devised a new galvanometer which, as has been proved by use, meets the requirements of all around testing to a most satisfactory degree.

The features of this instrument which render it of such value are deadbeatness and sensibility. In consequence it is not affected by mechanical vibrations and proximity to masses of iron or intense magnetic fields, and can be used alongside of dynamos, when running in the streets of large cities, on shipboard and, in fact, everywhere. The makers claim that no other galvanometer is adapted to such universal use.

The coils in the rheostat and bridge are wound with platnoid wire and guaranteed accurate to one-fifth of one per cent. A special "reversing attachment," employed by Queen & Company in their standard resistance boxes, is supplied, which gives a maximum range from .001 to 11,110,000 ohms.

The makers have just issued a neat circular, No. 285, which sets forth the advantages of their testing sets and will send a copy to interested parties.

Utilization of Niagara Falls—Scheme by Messrs. Ganz.

Messrs. Ganz & Company, Buda-pesth, having been invited by the Cataract Construction Company to participate in the Niagara competition, submitted a scheme, the details of which accompany this article. Fig. 1 shows the mode of suspending the vertical turbine shaft; Figs. 2 and 3 show the relation of the various turbine shafts in the installation of 5,000 horse-power.

In preparing these plans, says a correspondent of *Engineering*, the first and important point was to find the most convenient arrangement and size of turbines capable of developing the effective power of 125,000 horse-power under the stipulated special conditions. Messrs. Ganz and Company deemed turbines of 1,000 to 2,000 horse-power impracticable, because such turbines, in order to produce the aggregate efficiency required, necessitated more appliances, thus adding to cost, because the relative efficiency of several small turbines is less than of one large turbine of equal power. It was necessary, in the first place, to find out the greatest efficiency possible for which a turbine might practically and with perfect reliability be constructed, and after much experiment and calculation on this point, Messrs. Ganz & Company decided to design 25 turbines, each of 5,000 horse-power, for driving the dynamos.

As it seemed to be certain that the dynamo room could not be made underground in the water-wheel room, the next point of solution was the conducting of the 5,000 horse-power from the turbines to the dynamo room erected above ground. Were the power to be transmitted by ropes or belting, the rock shaft would require to be so large that the cost would be excessive, in view of the hardness of the rock to be bored; and owing to the use of vertically superposed pulleys of such dimensions without guide pulleys light would be greatly diminished. Messrs. Ganz & Company, therefore, decided to transmit the power from the turbine wheels to the dynamo room by a vertical steel shaft. A magnet wheel is fixed on this shaft, which considerably augments the vertical load to be carried. But a special patented type of bearing which Messrs. Ganz & Company have adopted completely meets this difficulty.

The head race is provided with an inlet sluice, having wood gates nine feet in height and nine feet in width; operated by hand-wheel from the platform. Behind the sluices there is a basin with concrete walls with a cylindrical sluice. This consists of a cylinder of three-eighths inch plate iron, the bottom part of cast iron, being slightly turned inwards to fit on the bell-mouth of the funnel bedded in the concrete liner of the supply shaft. The circular sluice is, owing to its special shape, free of pressure from the water, and may be hoisted by chains passing over guide pulleys to any convenient point of the engine room. A load on the end of the chain counterbalances the cylindrical sluice. The sluices serve to cut off the water supply when the apparatus is standing idle for a long time, but they are not intended to open or close suddenly. An arrangement for this purpose would have been too heavy and impractical, and the result is obtained in a better and easier way by the air cylindrical sluice. The supply shaft is a vertical rock-shaft lined with concrete. The lower part of the shaft turns to the turbine in a curve, ending in a tube of three-eighths inch plate iron, stiffened with angle irons fixed in the concrete. The lower flange is screwed to the turbine chamber. The mean velocity of water in the supply shaft is supposed to be seven feet, accordingly the diameter equals nine feet, and the quantity of water equals 414 cubic feet per second.

The turbine pit has in its entire length an oval section, ending below, however, in a circular opening of larger diameter, in order to obtain more room for operating near the turbine. The turbine pits are connected one with the other by horizontal culverts (Fig. 2), permitting passage from one turbine to the other. These culverts, besides, would be serviceable during the boring of the shafts, enabling operations to be started either from above or from below, and for the removal of material. The dimensions of the pit have been minimized as far as consistent with the necessity for allowing sufficient room for raising the motor in pieces in the event of repairs being required. Although a turbine of 5,000 horse-power may run in the pit, its greatest diameter is only 12 feet, and there is nothing in the pit which could not be taken apart.

This plant closely resembles the Assling-Sava turbines described in *Engineering* of August 28th and September 11th. The turbine wheels are in this project also axial-flow wheels. The driving-wheel is keyed onto the shaft, and is supported by a conical ring of two pieces. The buckets of this wheel are made in such a way that the wheel may run even in the backed-up water of the tail-race without great loss of efficiency. The guiding wheel is placed in a bed-ring, bedded in concrete and bolted to the turbine chamber. This chamber consists of two parts, the upper fitted with a stuffing-box, through which the regulating tube passes. The cast iron box is intended to take up the lateral pressure of the water to the right side of the turbine. If the

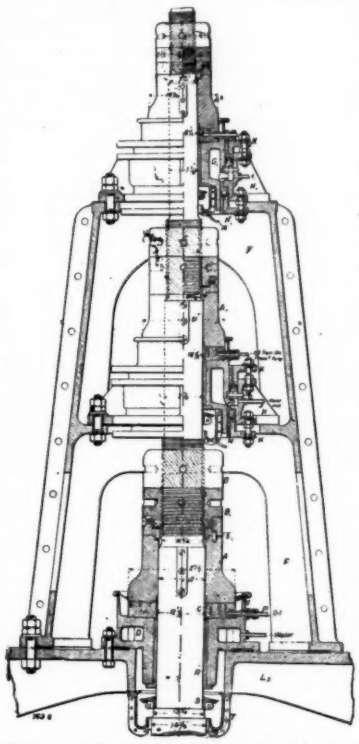


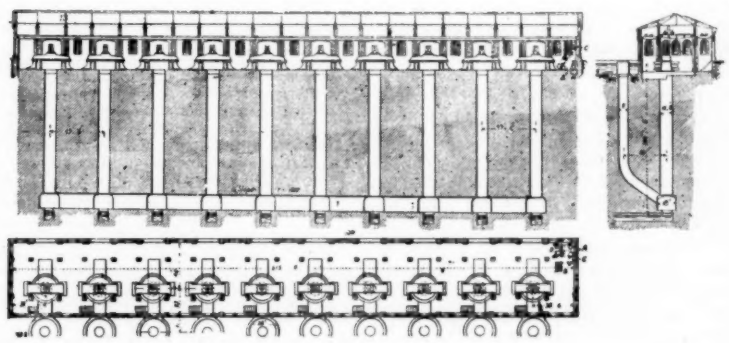
FIG. 1.—GANZ & COMPANY'S NIAGARA FALLS PLAN.—SECTION OF TURBINE.

vertical shaft were made of solid steel, its diameter would be 14½ inches, 5,000 horse-power being transmitted while running at 125 revolutions. It would be preferable to make the shaft hollow, of compressed cast steel, as its weight would thereby be considerably lessened. The shaft consists of several pieces, which are connected together by bolts and a cross-key. The shaft is guided above the guiding wheel by a sleeve, in which are inserted five strips of *lignum-vitæ*, fitted on their outer sides to take up the pressure of three steel adjusting screws. The shafts above the turbine run in guiding bearings. In the concrete are bedded the two irons, projecting very slightly into the pit, so that the space for fitting up the turbine may not be obstructed. The cross girders are screwed to the main beams by angle irons. The cross beam, as well as the bearing proper, are in two parts to be easily taken off. The bearings have an inner diameter of 14½ inches.

The dynamo is placed above the floor of the dynamo room to be easily accessible. The magnet wheel is fixed on the shaft, 16 inches in diameter, by a conical ring and keys. Two strong rings, each in two halves, support the induction coils and are fixed onto the large cast iron supports. The big horizontal frame rests on these supports, bearing the shaft and all parts connected with it. The two supports are tied to the foundation by strong screws, 16 feet long. Inner stairs lead to the frame and to the gallery, where the bearing of the turbine rests.

The weight of the shafts, of the magnet wheel, of the running wheel, and of other parts suspended on the shaft, and, finally, the axial pressure of the water exerted on the blades of the running wheel, Messrs. Ganz & Company calculate as totaling 125 tons. This load is suspended on a shaft running at 125 revolutions. To secure the shaft in a reliable way, Messrs. Ganz & Company have chosen the construction shown on Fig. 1 annexed, which is in part the same as executed for Assling-Sava. A bell-shaped cap, Fig. 1, adjustable by nuts B, B, runs on a gun-metal ring C, and is keyed on the shaft. Three eccentric grooves cut in the ring are connected with a pipe, into which a small pump forces oil. Thus the supporting surfaces are converted into a fluid bearing. The space D is for cooling water, should it be necessary. For the enormous load of the shaft of the Niagara turbines this bearing alone is not sufficient. To assist the bell-shaped cap A resting on a fixed frame, there are two other caps, A_1 and A_2, above A of similar design, but running on hydraulic plungers. The water from the accumulators enters throught the pipes T_1 and T_2. The upward pressure exerted upon the difference of the areas of the circular N N is intended to raise the plunger and the cap. The lubrication of the caps A_1 and A_2 is the same as in the case of cap A. Although this bearing is quite sufficient to carry the whole load of the shaft, Messrs. Ganz give increased surety by employing the hydraulic tail-race piston. To get the necessary pressure of water for the hydraulic tail-race piston, they are fed by pumps. Means are provided to collect and clean the oil from all shaft bearing. All the oil descends to a vessel divided into two sections by a vertical partition wall. The oil enters at the bottom of one of these parts and flows over the partition into the second, leaving behind any impurities. A special suction pump, driven by a hydro-motor, pumps the oil into the filter, where the oil is cleaned by two layers of cotton and used again. The level of the tail-race of the various turbines is intended to have a slope of seven to 1,000, according to the slope in the main tunnel. A similar slope is given to the tail-race of all and each turbine into the main tunnel under the beveled wheels. Space must be provided for examining and cleaning the buckets of the wheels to admit of the shutting off of the water. This space is fitted with a sluice. The gates are of wood and guided by slots formed of channel iron on edge and secured in the wall. The hoisting gear of each gate consists of two hydraulic cylinders secured in the concrete and fed by the accumulators already mentioned. An apparatus fixed in the turbine chamber serves to govern the gate. After lowering the gate the water may be pumped out by an ejector. The exciting current is taken from a separate continuous current exciter, driven by beveled wheels from the turbine shaft, developing 100 horse-power while running at 300 revolutions.

Referring to the ground plan of the guide wheel, the channels are divided into four sections forming on their upper end a saddle the sides of which enclose a right angle. On this saddle is located a valve keyed onto the protecting tube by four brass bolts and adjustable by screws in vertical direction. These screws permit the regulating at will of the distance between the guide wheel and valve. The protecting tube may be tin on a brass spur running near the stuffing box. The tube has a funnel shaped prolongment in order to counter-balance somewhat the great pressure of the water exerted on the valve by the tube as well as the valve. The buckets of the guiding wheel may be opened or closed from *nil* to full. The tube is guided above by a box separating the toothed sector operated by the single acting cylinder and its rack. The cylinders are connected one with the other by strong horizontal forms resting backwards on the liner of the pit. These cylinders receive their feed water from the same accumulators that feed also the tail-race piston. The governing of these cylinders is operated by an apparatus receiving its motion from the centrifugal governor. The governor is driven by beveled wheels from the shaft of the exciter. The distributor is operated by a reversing needle from the governor and is connected by pipes with the cylinders. The regulator has to move only the distributors which permit the water of the accumulators to enter either into the one or the other cylinder. Thus the rack and the protecting tube and the shaft is connected with the connecting tube, by two toothed segments, being at the same time geared with beveled wheels, shaft, gear and the rack. This mode of connection permits the centrifugal governor to remain in a certain position without oscillating until the moment when its velocity is altered.



FIGS. 2 AND 3 OF SAME.

High Speed Inter-Urban Railways.

BY C. ZIPERNOWSKI, BEFORE THE ELECTRICAL CONGRESS, FRANKFORT.

The author proposes a line between Vienna and Buda-Pesth, a distance of 250 kilometres—say, 150 miles—and a speed of 150 miles per hour, which he considers the maximum the wheels will stand without danger of flying to pieces. The trains would consist of one carriage, seating 40 passengers, carried on two bogies, with solid steel wheels eight feet in diameter, the driving power being four 200 horse-power motors, working at 1,000 volts, which necessitates collecting, therefore, by contact from a center raised rail, some 600 amperes. The up and down lines must be about 10 metres apart, to avoid the shock of air, when two carriages pass, blowing them off the rails. There must be no curves of less radius than 3,000 metres—say, 1.8 miles—and for these the outer rail must be raised 15 centimetres (six inches). The power would be supplied from two stations, at 10,000 volts alternating, which would either be transformed down or redressed to direct current, at 1,000 volts.

Perfection of Railway Travel.

The inauguration, by the Baltimore and Ohio, Philadelphia and Reading, and Jersey Central Railways, of the famous "Royal Blue Line" between New York and Washington *via* Philadelphia and Baltimore, was an event of the greatest importance to travelers, and it is very gratifying to chronicle the great success and popularity it has attained. It deserves it fully, for it is emphatically the best line ever run between the two cities. We say the best from personal experience, for we have traveled over it and its competing lines, and when we say that over the "B. & O." route the highest realization and perfection of railway travel is attained, we are but giving it just praise. Its trains are the safest, the finest and fastest in America, and are run "on time." A vestibuled limited express, equipped so completely and luxuriously as to leave nothing to be desired, is run between New York and Washington in each direction in exactly five hours, which is not only the fastest time ever made between the two cities, but is the fastest train in America, and the splendid road-bed of the route permits the speed with perfect safety. One can realize what a fast train this is when it is considered that the distance from Jersey City to Washington is almost exactly the same as from Boston to New York, and, whereas, six hours is the fastest time ever made between the latter cities, the Royal Blue Line's train from Jersey City to Washington performs the journey in four hours and 48 minutes. Notwithstanding the superior equipment and train service of this line, no extra fares are charged on any of its trains. Palatial day coaches accompany all its trains, open to the public at the regular fare, and only the usual charges are made for accommodations in sleeping and parlor cars.

There are six "Royal Blue Line" trains each way daily, between New York and Washington. All of them are composed exclusively of vestibuled cars, protected by Pullman's anti-telescoping device, heated by steam and lighted by the Pintsch gas system.

We heartily recommend this route to all our readers, and advise them to take it and none other, for it is not only the best, as regards speed, luxury and equipment, but it exacts no extra charge on any of its trains. —*Christian Leader.*

AN INSTRUCTIVE ADDRESS.

Professor Forbes on the Developments of Electrical Distribution.

Professor Forbes' second Cantor lecture at the Society of Arts in London, is a very excellent *resumé* of foreign practice in central station distribution and well worth the perusal. The lecturer, in his opening remarks, urged the importance of not slurring over actual difficulties that were before them in the matter of distribution. They were looking at the question of distribution from an engineering point of view, and it was desirable always to face the difficulties, and, to see their way, rather than pretending they did not exist. In his previous lecture he pointed out the chief causes of excessive expense in distributing electricity through towns. There is, first, cost of distribution, and, second, cost of generation, and in both cases expense of production and distribution was greater than it would be if they were producing electricity for their own purposes at a constant rate. The want of regular distribution injured them in two distinct ways: First, through their engines, and, second, through the boilers. Owing to the fluctuating demand for light, they were compelled to vary the number of engines to supply the mains, and this necessitated engines running often below their economical load; there was also a great amount of coal burned in heating the boilers for the two hours' run. Few people, in the lecturer's opinion, realized what an enormous loss there was when they were running powerful engines at light loads, more especially compound engines. Of course, that difficulty could be surmounted by employing tolerably small units; but with respect to boilers they were without remedy at the present time. Great attention was given to this point by Mr. Crompton in a paper read before the Institution of Civil Engineers, in which he introduced the term "Load Factor."

The "Load Factor" was very important, but an important thing in connection with this was that no one exactly knew what it was. Mr. Crompton introduced five distinct definitions of the load factor, each of them giving totally different meanings. He would endeavor to give them a series of definitions which he trusted would suffice for all future purposes; he had hoped before this that Mr. Crompton would have given them an exact definition, but he had failed in that, and, therefore, he (the lecturer) would give what he thought would suffice for engineers. Professor Forbes here drew attention to the diagrams illustrating the load curves of the Berlin station. Coming again to the question of load factors, he said Mr. Crompton tried to indicate by this the ratio of the average quantity of electricity to the maximum, but what maximum was to be chosen was not defined. He, the lecturer, proposed to adopt three distinct definitions: The machinery load factor, the current load factor, and the temporary load factor. The machinery load factor for days, weeks, months or years, meant the ratio of the average current during that period to the maximum current of which the station is able to give out. By the current load factor for any day, week, month or year, he meant the ratio of the average current during that period to the maximum current which was required during any part of the year; and by temporary load factor, he meant the ratio of the average current in any day, week or month, of that period to the maximum which is used during that period. If they adopted those three, he thought they would be sufficient for all purposes.

HIGH PRESSURE SUPPLY.

It was obvious from the very earliest attempts of low tension distribution that there would be considerable loss if they attempted to increase the distance. The remedy for the difficulty lay in the use of high pressure which involved small wires, at any rate for long distances. There were two attempts made in this direction, one was by means of storage batteries, and in his previous Cantor lecture, in 1885, he gave an account of such an attempt which had been made in Colchester. That scheme, however, died from various causes, one being that the batteries employed were not thoroughly reliable. An exactly similar scheme had since been worked out in Chelsea by the engineers who superintended the Colchester system. Here they had an example of storage batteries put into sub-stations which were charged in series by high tension mains, and which then discharged into the houses by independent low pressure mains. That system, as the result of working some time, might be considered in many ways satisfactory, the only serious objection, perhaps, being the cost. The other method used was an arrangement of parallel series distribution; lamps and mains were divided into groups, each group was put in parallel and the successive groups were put in series; it would, therefore, be possible to have a dynamo working at 400 volts, and there would be five main wires in the distribution; the lamps would, of course, be placed between the first and second, third and fourth, and so on. By this means each group of lamps, of which there were four, would only be taking its 100 volts while the dynamo was giving off 400 volts; they would thus be able to go four times the distance that they would in ordinary distribution, and twice the distance of the three-wire system. That system has been adopted in several places abroad, and so far back as 1885 had been used at Temesvar, in Hungary. The most notable was, perhaps, the Sector Clichy, in Paris.

The difficulty in this system was when, at any time of the day, the number of lamps on the different groups were not equal, the group using the fewest lamps would be too bright, and the groups using the greatest number of lamps would be too dim. Various attempts had been made to get over this trouble, and he, the lecturer, at the Cantor lectures of 1885, showed an arrangement of automatically switching lamps from one set of mains to the other, which, however, was too complicated to be of much use. Another plan which had been introduced in the Sector Clichy, Paris, was to introduce in different parts of the network what was called a compensator, which consisted of four dynamos, each machine being connected to one of the four groups. In the case of a group requiring full pressure the dynamo acted as a generator, but in the groups where there are few lamps it acts as motor, absorbing the current. This, however, was not a satisfactory arrangement, and was, moreover, very wasteful, and the directors of the Sector Clichy are about to abandon the method. The alternative to which they had been driven was to use batteries of accumulators to act as regulators. Fifty cells are placed in different parts of the mains, between each of the pairs of mains, in parallel with each group of lamps. The batteries will thus maintain the pressure, and if there are too few lamps between the groups, the current will pass through the batteries and charge them up. The method behaves well, but batteries were, of course, an expensive item, and if there were a more economical system it would be preferable. They would notice that this system was analogous to Hopkinson's many wire system, an extension of his three-wire system, patented by Hopkinson and Edison simultaneously. The difference is that in Hopkinson's there is not a dynamo of 400 volts, but four dynamos each of 100 volts.

Coming to other high pressure systems, the most important, and the one which had received the greatest developments, was the alternating current transformer system. The convenience of this was enormous; they were able to send an alternating current through an extremely fine wire to a great distance, in fact, a main of the twentieth part of the section required in the low tension system.

It was, of course, dangerous to bring high tension currents into the houses, but a properly constructed transformer gave them the utmost immunity from danger, and effectually prevented the high pressure currents from entering the houses. He regretted that was not always done in practice, but there was no excuse for bad work in that way. The alternate current was peculiarly suited in another way to distribution, and that was a point which had not been sufficiently attended to in the past. The method which he had suggested was about to be adopted in the City of London lighting. They would remember, when lecturing last week, that he showed there was some difficulty in regulating the pressure in the low tension systems, but there was not the slightest difficulty in that way with alternating currents. That could be done by using a choking coil; by this means they were able to reduce the electromotive force on the feeder without consuming energy. Another method that was also equally applicable was, when the current was passed through a transformer in the central station, they could take off the current from the whole of the secondary coils in the transformer; they might, by adjusting it, take off current at 100 volts, or any other voltage required. Those two methods would be, in the future, of the utmost importance in alternate current distribution. The alternating current had been objected to on a great many different occasions by those who were interested in supporting low tension, and by those who did not fully appreciate the merits and advantages of the alternating current. There had been certain disadvantages connected with it, but he hoped to see them removed.

THE USE OF ALTERNATING CURRENTS FOR MOTORS.

The first important difficulty that they need pay attention to was that hitherto alternating currents had not been suitable for driving motors. This, however, was not so serious a difficulty as it looked at first sight. The experience gained, where motors had been put on lighting circuits, had not always been favorable to that arrangement, and in many central stations it had been found desirable to have separate machinery and separate distribution mains for motor circuits. When motors and lamps were on the same circuit, sudden heavy work put on the motors made the lamps dim. In a motor system of distribution, the regulation of pressure to a very great nicety was not of such great importance, but in lighting it was of the utmost importance. The chief reason for putting motors on was, that it was thought the motors would improve the load factor, but it was not the case, for the two were bound to overlap at the time of busiest working. He believed that in the future development of central stations by means of the alternating current, they would have entirely got rid of these difficulties. Another difficulty which really needed remedy was in electro-chemical operations. In this case the alternating current was not very suitable. Of course, they could not charge batteries, nor could they use the alternating current in electro-deposition; but it was generally, for such purposes, cheaper to generate electricity direct than to take it from a supply company. As to storage batteries, it was very convenient to be able to charge storage batteries; but so long as they did not require any reserve power, the necessity for storage batteries diminishes, and as the result of very great experience in the past, they were improving every year in the certainty of their supply, so that at the present moment there was really an infinitesimal number of central stations being called upon to supply electricity from storage batteries, and every year the possibility of such a thing was diminishing.

SUB-STATIONS VS. HOUSE TRANSFORMERS.

He had said that there would be some considerable changes in their methods of distributing electricity by means of the alternating current, and the greatest alteration which he expected to take place would occur in the introduction of sub-stations. Up to the present time it had been the custom, when using alternating currents, to put transformers in the customers' houses; but it was somewhat costly to make separate transformers; it was also not convenient to put transformers in the houses, for the reason that it was difficult to regulate the pressure so as to keep the pressure perfectly constant at all hours, because, in addition to the changes in pressure owing to the distribution, they had actual loss in transforming, and although the greater part of this loss was constant and did not affect the distribution problem, there was a certain amount variable with the load. If they introduced sub-stations where the pressure could be regulated, and where low tension was then distributed, they had a means of regulating the pressure, which could be done by an attendant in the sub-station, provided that they made them large enough to make it worth while to employ an attendant. There was not the slightest doubt that they would be able to do this in another manner, and to make the transformers self-regulating to a certain degree, so that it would be possible to place large transformers in underground vaults, or in places where they only required very occasional inspection. There had been several inventions made in this direction, and he had hoped to have shown some of the latest arrangements of Mr. Ferranti, but a little difficulty with foreign patents prevented this. It would be seen that it was possible to arrange an automatic switch so that when the demand for current was great, an additional transformer could be switched into the circuit, and when the current fell off, the switch would act in the opposite direction and put in a smaller transformer. It was, also, possible to wind the primary and secondary coils of the transformers with more than one wire, and to have an arrangement by which the primary and secondary coils could be put in series or parallel simultaneously, according to the different demands for current, that would also get over their difficulty. The effect of such changes would be to make the dynamos work at economical load. There was always a hysteresis loss in a transformer, and that loss was fairly constant whatever the demand for current might be, but by proportioning the size of the transformer to the load required, they were able to make the hysteresis loss a small proportion of the total current required to keep the transformer working at efficient load. Under the present arrangement of a transformer in every house, they were working in a very inefficient manner during the time when the load is light, and during the daytime, when no current is being taken at all; but with the sub-stations supplying the secondary low tension current to the mains, there would be a very small number of transformers at work during the hours of light load, consequently they might look for an efficiency of 90 per cent. during the whole 24 hours. The feeling among engineers at the present time was, that sub-stations ought to be introduced instead of the house transformer, and they could look with certainty to this result in every large system of transformer distribution. If they were going to introduce the system of sub-stations, it became necessary to review the whole of the system of distribution and see whether they were working in the right direction. There was one point requiring radical modification—the frequency of alternations. To carry out the work economically, the pioneers of electric lighting used small transformers, with high pressure of 1,000 volts. To do this they used dynamos which gave very rapid alternations; the result was a considerable rise of energy in the hysteresis of the transformer. When they came, however, to the sub-stations, the economy to be gained by using high frequency was not nearly so large, for that reason, it would be desirable to reduce the frequency of their alternations as low as the frequency in an ordinary continuous dynamo armature; that is, reduce from 130 periods per second down to something like five or ten periods per second. When they had a secondary main of a large section, it was with difficulty they could force a current of high frequency through. Such a current had a remarkable effect on the conducting qualities of large conductors; the current was forced into the outside of the conductor, and made the inside of the conductor almost useless as a means of carrying the current. It was only by diminishing the frequency of the alternations that they would be able to get over the very serious trouble which would arise as soon as they had low tension mains carrying alternating currents. Low frequency currents at once solved the problem of the electro-motors. They knew perfectly well that alternating current motors were being developed which were said to be far superior to the continuous current motors, and, consequently, the development in this part of the subject would be in the types of motors which had attracted so much attention elsewhere. Even in these motors, however, low frequency would be an advantage. Low frequency would also enable them to introduce a commutator in such a way as to convert alternating current into a continuous, by this means enabling them to charge storage batteries. Other systems of high tension had been proposed, the most important of which was the continuous current transformer. These combined machines were of the highest efficiency, owing their value to two sets of winding annulling the armature reactions. Although high pressure electricity was perhaps the most economical means by which they could transmit power from one place to another, there were several means which were worthy of consideration, such as compressed air, hydraulic pressure and gas, and he begged electrical engineers not to cast aside as utterly useless these other methods. Speaking of power obtained by gas, the lecturer said the Dowson gas was extremely economical, and the question came in here whether it was ever economical to introduce gas engines in sub-stations instead of steam. Personally, he had no hesitation in saying that in many cases they were most economical, and as the demand arose for larger engines of this class, so would they be made. The question of gas engines had attracted the attention of engineers, and in designing central stations in the future, the matter would not be lost sight of. The lecturer concluded by referring to the systems of laying mains, which, however, are well known to our readers.

New Brass Manufacturer.

A new stock company, known as the Framingham Brass Manufacturing Company, has been organized in South Framingham, Mass., with local capital invested. The company will manufacture sheet brass goods, brass electrical chandeliers and the like, and has a paid in capital of $6,000. A well known Boston manufacturer of electrical supplies is interested in the concern; 25 hands will be employed at first and in the course of a few months over 100 hands will be given employment.

Radiation of Electric Energy.

BY FRED. T. TROUTON.

In Fig. 1 is shown one of Professor Hertz's original pattern radiators; it is in principle the same as the one in Professor Lodge's experiment. The square metal plates to right and left correspond to the outside and inside coating of the jar. It differs in the current alternating somewhat more rapidly. The time elapsing between each swing is about $\frac{1}{500000000}$ part of a second. That is to say, if the oscillations continued for one second, 30,000,000 would have taken place. In order to form some idea of the stupendous rapidity with which they succeed each other, I may mention that a clock ticking once every second would require to be kept going for 347 days (almost a year) before its pendulum would have performed the number of vibrations that would here take place in one second. As a matter of fact, only a dozen or so of these vibrations really occurs,

FIG. 1.

so rapidly is the energy radiated, each one being less than the last, like the vibrations of a string of a musical instrument.

Just as, in Professor Lodge's experiment, a spark is produced in a receiver identical in form with the radiator, placed at some little distance away; but as this is small, it is often convenient, when wishing to exhibit to a number at once, to use a sensitive current detector with a spot of light in the usual fashion; for by its means, curious enough to say, we are able to see when the receiver is affected. The wires leading to the detector are connected one to either plate of the receiver.

Non-transparent objects, such as metal sheets, can cast shadows and stop their electric radiations just as they would with light. As a rule, things which stop light stop these radiations, and things which let light through let them through also. In this respect, and in many others, which we will refer to later, there is the greatest resemblance between the properties of light and of these electric radiations. Maxwell, many years ago, anticipated such, and suggested that light itself was but an electric radiation, with an extremely high rate of alternation. Amongst other reasons brought forward for supposing this was that the speed, calculated from purely theoretical considerations for electric radiations, agreed precisely with what had been found to be the speed of light—180,000 miles per second. It remained, however, for Professor Hertz to put the matter beyond all doubt by measuring the speed by actual observation; and we will now endeavor to see how this was done by employing a rope as an illustration.

Suppose one end of the rope fastened to the wall, the other held in the hand, when the unattached end of the rope is given a shake, a wave is observed to pass up along it; and if one watches closely one will see that when the wave reaches the fastened end another wave apparently starts and travels back along the rope. That is to say, the wave is reflected at the end and comes back to us. (Fig. 2.)

By continuing to shake the free end at a uniform rate, waves, consisting of a number of hills separated by hollows, can be sent traveling along the rope; each of these, of course, must be reflected at the fixed end, and ought thus to form a procession of waves passing back along the rope. But this is not as it will appear to us, for we must remember that what we actually see is the result on the rope of a continuous procession of waves going up to the end, as well as of those coming away after reflection.

The combined effect of these two processions of waves traveling in opposite directions, thus produced by reflection, is seen to be that there are a number of points along the rope, situated at equal distances apart, which remain at rest, and never go up to make a hill or go down to make a hollow. And if we think for a moment this is the only thing the rope could do; for each hill returning from the fixed reflecting end must at certain points meet the oncoming hollows. Now, the returning hill tends to raise the rope, while each oncoming hollow tends to move it downwards; the result is, where they meet the rope has to remain at rest. Again, between these points the returning hill encounters an oncoming *hill;* and here, when this happens, the rope gets an increased swing up. It is in like fashion for two hollows, which are in truth but hills when viewed from the other side. In this way we see the rope is thrown into portions, which vibrate strongly, these portions of rope being separated by points which remain always at rest.

Now, the distance from one point of rest to the next is half the distance the waves travel in the time of one vibration, for it is obvious a returning hill is met on each occasion halfway by an oncoming hollow; for they are both moving at the same rate and in opposite directions, so that, by measuring this distance, we can find the speed the waves travel at, provided we know the time taken for each vibration.

It was after this fashion, then, that Professor Hertz succeeded in determining the speed of electric waves. By means of a reflecting sheet of zinc the waves traveling in the opposite direction to the original ones were produced; and these at certain points destroy or neutralize each other's action, just as we have seen is the case with the waves on the rope.

In this way, then, by measuring the distance apart of these points, one is able to determine the speed these electric waves travel at, provided the time the current takes to alternate is known, and the way to ascertain this by calculation was shown long ago by Sir William Thomson.

Among some of the other points of resemblance between these electric rays and light, to which I alluded before, is (1) that these rays were found by Professor Hertz to be bent to one side on passing through a prism, just as we know light to be by passing it through a glass prism. (2) Again, these electric rays are found not to be reflected by ordinary thin sheets of glass,* though thick sheets, or in that case, more properly speaking, walls of glass reflect strongly. This is quite in agreement with light for extremely thin sheets; for instance, soap bubbles, when just about to burst, reflect no light, as is well known; ordinary sheets of glass being equally thin compared to our long electric waves, as the thinnest soap bubble is to the minute waves of light.

Further, to make the likeness more complete, I may mention that when soap bubbles are viewed with monochromatic light (*i. e.*, light of one color), as the sides of the bubble drain away and become thinner the bubble goes through stages of reflecting and of not reflecting the light, according to the thickness—that is to say, at a certain thickness there is reflection; at a little thinner than this there is none; at a little thinner again there is again reflection, and so on, till the bubble bursts. In like manner walls—for such the thin sheets have to be in the case of these long electric waves—have been found to reflect or not to reflect, according to their thickness, after the same fashion.

Another, and perhaps a more striking resemblance, is that (3) both light and these electric waves refuse or allow themselves to be reflected obliquely from non-metallic surfaces, according to the direction they are vibrating in.

Without going further, we see there is abundant evidence to show the great resemblance between light and these electric waves. In fact, there can be no doubt but that they are in every way identical, excepting in so far that, in the case of light waves, the undulations succeed each other with exceeding rapidity, compared with the electric waves we have been dealing with.

We thus are brought to the conclusion that, could we only contrive an electric radiator after Prof. Hertz's plan, which would vibrate fast enough, and send out successive undulations at short enough intervals, we would have a source of illumination, for the radiation would affect our eyes, and be in every respect what we know light to be.

Many experimenters are at the present moment working at this problem from different directions, the great *desideratum* being the production of light without the simultaneous production of useless heat, which occurs in all the means we now employ for artificial illumination. Instances of the production of light without heat are to be found in the light emitted by many organisms, such as the glow-worm; and in the illumination afforded by certain substances after exposure to bright light, such are often put up in small tubes and ornamental designs for the purposes of exhibition. After exposure to bright light they continue to glow for some time, although they remain quite cool.

Many of these substances also glow when placed in tubes exhausted of air and an alternating electric current passed over them.

What we do here is apparently to give the molecules of these substances a great shake every now and then, they continuing to vibrate between each disturbance after their own fashion as little electric radiators, thus affording us light. Experiments lately made by Professor Tesla, of America, seems to show that the more frequently they are disturbed the better. An ideal, of course, would be to give them a help each oscillation by a synchronous alternating current. Professor Tesla has built an alternating dynamo which afforded currents alternating 20,000 times a second; but this is far and away short of what would be required, if in truth such a thing is possible, as a circuit carrying a current alternating in periods comparable with that of light. The speed of rotation and the number of coils which can fit on a rotating disk seems nearly reached in his machine; but by combining the principle of the transformer with that of the dynamo, we could push the rate of alternation beyond these mechanical limits; for instance, by passing an alternating current through the field-magnets of an alternating dynamo instead of the usual continuous current.

We might suppose this done by having two machines on the same shaft, the first arranged as usual, while the field magnets of the second derive their current from the armature of the first, and in such a way that when the armature coils and field coils are closest the current in the field coils should be zero. The current from the armature of the second machine would thus be of double the rate, for we have superimposed on the geometrical zero position of the armature coils which occur half-way between two field coils, zero position situated *at* the field coils. The two machines might, of course, be combined, only in that case the field magnets of our second machine rotate, and are in fact the armature coils of the first, while the second set of coils to form the second armature would remain at rest. Unfortunately, we cannot go on in the same fashion doubling the rate, only, indeed, adding subsidiary vibrations by further machines.

So far, the long electric waves, as distinguished from the short electric waves of light, are of a purely theoretic interest; but no doubt they will be turned by man to subserve useful purposes. The great difficulty which lies in the way is, that the radiation produced by the automatic method with intermittent supply of energy, the only one yet used, is necessarily insufficient in intensity to be powerful at considerable distances, owing to the vibrations dying rapidly out, like that of a violin string. So that until some other form of apparatus is invented, to be supplied continuously with energy, so as to produce a continuous vibration, and to which we can harness on a 50

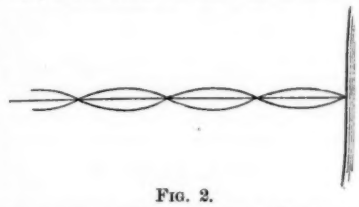


FIG. 2.

horse-power engine, and get a really powerful beam of these electric rays, there can be no great advance hoped for. Such an arrangement is, perhaps, possible through the device of affording two alternate paths for a continuous current, each of these being interrupted by a spark gap, and the arrangements being such that either spark in turn was magnetically blown out by the action of the current as soon as it had started; a definite resonant period, by the attachment of a condenser, being imposed, after the fashion of an organ pipe.

There is little doubt but that a powerful beam of this sort would, unlike light, be unabsorbed by fog; so, looking into the future, one sees along our coasts the lighthouse giving way to the electric house, where electric rays are generated and sent out, to be received by suitable apparatus on the passing ships, with the incomparable advantage that at the most critical time—*in foggy weather*—the ship would continue to receive the guiding rays.

It had often been a matter of surprise that human beings, the highest in the scale, were unprovided with electric organs of some kind or other, while other creatures of more humble type were so endowed; for instance, the electric eel with its destructive powers. But that we have electric organs, and those of a most beneficent nature, is now known; for science now shows us that our eyes are but resonant receivers of the minute electric waves which constitute light.—*London Electrician.*

*As glass happens to absorb these long electric waves, it is not so suitable for making the experiment with as other dielectrics, but for convenience of expression is spoken of here.

Electric Coal Cutter.

The coal cutter recently illustrated in the REVIEW, on which was mounted a "C. & C." motor, is meeting with success in the coal mining field. The manufacturer of the coal cutter is installing quite a number of them in the coal mines of the country, in connection with the Thomson-Houston motor. The days of the coal pick and, to a large extent, of the smudgy-faced miner would seem to be relegated to the past, and electricity in this case, as in thousand of others, should receive the credit for the change.

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Mr. M. C. Sullivan has accepted the New York agency for the products of the New Process Raw Hide Company, of Syracuse, N. Y. Mr. Sullivan's offices are at 136 Liberty street, Electrical Exchange building.

The Dallas Electrical Supply and Construction Company has combined with the firm of Hunter & Booso, supply dealers of Dallas, Texas. The new firm is a strong one and will do a general electrical supply and construction business.

A Good Idea.—The Cassier Magazine Company, Potter building, New York, is sending out to its clients and friends a neatly devised envelope for filing duplicate advertising contracts. The names of the prominent class journals are printed on the back and spaces are provided in which to write necessary data.

The Interior Conduit and Insulation Company, 42 and 44 Broad street, New York city, have just issued a very handsome catalogue of the Johnson switches which they manufacture. This neat, compact and efficient switch is making its way rapidly to popular favor through its many superior qualities.

The Pennsylvania Electric Engineering Company, Penn Mutual Building, Philadelphia, has been incorporated with a capital of $25,000. Arthur L. Bosley, president and manager; Benj W. Tingley, vice-president; Lewis R. Schultz, secretary and treasurer, and F. S. Koons, assistant secretary. The company was formerly a co-partnership existing between A. L. Bosley and Lewis R. Schultz. It is a live concern and manufactures the well-known "Pennsylvania Lamp."

The Frink Reflectors, manufactured by I. P. Frink, 551 Pearl street, New York, are thus mentioned in a recent issue of *The Christian Advocate:*

What an awakening there is among good people generally on the question of comfort in their homes, and brightness and beauty in their surroundings. This is as it should be, but is not as it used to be. The world moves and the age is a progressive one. We no longer depend on the candles of our fathers, but enlighten our evening by electric sparks that leave gas and tallow in oblivion; and, by the use of the wonderful Frink reflectors, diffuse in our large assembly rooms and large halls and church buildings, a sweet, delightful illumination that greatly adds to the enjoyment of modern life.

H. Ward Leonard's methods of electric motor control, which he exhibited for the first time at the Montreal Convention, and upon which he has recently secured broad patents, has met with great favor at the hands of the electric elevator people. Mr. Leonard has granted licenses to the Otis, Crane, Hale, Stokes & Parrish and Whittier Elevator Companies, and electric elevators operated under Mr. Leonard's method are being rapidly introduced by these companies. This elevator is very popular with the central station managers, as it uses so small a current in starting up the elevator as to have no effect upon electric lights on the same circuit. By Mr. Leonard's method an electric elevator can be operated from an Edison three wire circuit, an arc circuit, a railway circuit or an alternating circuit, which gives it an exceptional flexibility.

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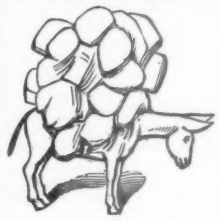

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Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 72 in. x 60 in. x 15 ft.; 72 in. x 60 in. x 20 ft.

Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.

Crank Shapers, 6 in., 8 in., 10 in., 12 in., 15 in., 16 in., 20 in., 24 in., 28 in.

Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.

Screw Machines, Nos. 5, 6, 7, 8, Power Feed.

Presses, Nos. 51, 52, 53, Ferracute, Nos. 1, 2, 3, Stiles & Parker.

5 Lincoln pattern Millers, No. 2.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MARCH 2, 1892.

469,802 Electric alarm clock; Joseph Yungbauer, St. Paul, Minn., assignor of one-half to Theodore B. Myers, same place.

469,806 Commutator brush and holder; Charles D. Jenney, Indianapolis, Ind., assignor to the Jenney Electric Motor Co., same place.

469,809 System of electrical distribution; William Stanley, Jr., Great Barrington, Mass., assignor, by mesne assignments, to the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.

469,828 Conduit system for electric railways; John E. Waller and Edward Manville, London, England.

469,856 Telegraph apparatus for branch offices; John B. Hurd, Red Bank, N. J., assignor to the Western Union Telegraph Co., New York, N. Y.

469,861 Contact device for electric railways; John C. Love, Philadelphia, Pa., assignor to the Love Electric Traction Co., Chicago, Ill.

469,862 Electro-magnetic machine; Robert Lundell, New York, N. Y., assignor of one-half to Edw. U. Johnson, same place.

469,873 Apparatus for illuminating cars of cable roads; Charles E. Scribner and Ernest P. Warner, Chicago, Ill., assignors to the Western Electric Co., same place.

469,890 Journal box; Amos C. Stilson, Bradford, Pa.

469,895 Extension electrolier; Chas. Deaur, New York, N. Y., assignor to the Archer & Pancoast Manufacturing Co., same place.

469,899 Trolley for electric railways; William H. Morgan, Alliance, O., assignor of three-fourths to Thomas R. Morgan, Sr., Thomas R. Morgan, Jr. and John R. Morgan, of same place.

469,905 Electrical releasing device for target traps; Paul North, Cleveland, O.

469,917 Armature winding for dynamo electric machines; Rudolf Eickemeyer, Yonkers, N. Y.

469,940 Insulator; Charles U. Hammond, Boston, Mass.

469,944 Power transmitting device for electric railways; Edward H. Johnson, New York, N. Y.

469,949 Electric soldering tool; Johann J. Ritter, Basle, Switzerland.

469,995 Electro-magnetic annunciator; Francis W. Dunbar, Newark, N. J., assignor to the American Telephone and Telegraph Co., of New York.

470,008 Electric light attachment for lamps; Ralph C. Putnam, Philadelphia, Pa., assignor to the J. E. Caldwell & Company.

470,013 Lightning arrester. 470,014 Fuse for electric circuits; Charles F. Scott and Alexander Wurts, Pittsburgh, Pa., assignors to the Westinghouse Electric and Manufacturing Co., same place.

470,038 Electric link welding machine; Charles L. Coffin, Detroit, Mich.

470,057 Dynamo or motor; Ralston C. Kintzing, Brooklyn, N. Y.

470,073 Electric battery; Erminie Ortelli, Cadenabbia, Italy.

470,080 Adjustable suspension apparatus for electrical translating devices; Harry D. Sisson, Pittsfield, Mass., assignor of one-half to Charles H. Robinson, same place.

470,095 Motor; La Motte C. Atwood, St. Louis, Mo., assignor to the Atwood Electric Co., same place.

470,123 Voltaic battery; Henry I. Harris, London, England.

470,129 Electric railway signal; William Holloway, Jr., Wayne, Pa.

470,155 Electrical device for stopping horses; Albert B. Holson, Chicago, Ill., assignor, by direct and mesne assignments, to the Holson Electric Harness and Supply Co., of Illinois.

470,158 Electric elevator; Carson J. Sturgeon, Erie, Pa., assignor to the Keystone Electric Company, same place.

470,161 Circuit interrupting device; Alexander Wurts, Pittsburgh, Pa.

MARCH 9, 1892.

470,194 Electric motor or dynamo-electric machine; Henry H. Hosford, Cleveland, O., assignor of one-half to Charles W. Foote, same place.

470,199 Electric motor or generator; Rankin Kennedy, Glasgow, Scotland.

470,204 Electric cut-out and safety device; Chas. R. Meston and Alexander W. Meston, St. Louis, Mo., assignors to the Emerson Electric Manufacturing Co., same place.

470,217 Connection for armature conductors; George Stephens, Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

470,221 Electric railway; Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.

470,231 Fire alarm and telephone apparatus; Edward H. Amet, Chicago, Ill., assignor to himself and Herbert A. Streeter, same place.

470,237 Conduit for electric wires; Charles A. Freeman, Steubenville, O.

470,256 Electric gas lighting burner; Horace A. Pinkham, Wollaston, Mass., assignor to George F. Pinkham, same place.

470,260 Electric battery; Vincenzo Riatti, Milan, Italy, assignor to Julian Goldsmid, London, England.

470,294 Electrical attachment for pianos; Fritz A. Feldkamp, Newark, N. J., assignor to Feldkamp, Schoenhaar & Lehr, same place.

470,318 Electrical wire stripper; Arthur Cuthbert, Maidenhead, England.

470,329 Underground conduit for electric cables; Carl A. U. Hultman, Stockholm, Sweden.

470,341 Electrical measuring instrument; Edward Weston, Newark, N. J.

470,356 Insulator for overhead electric railways; Henry D. Winton, Wellesley, Mass., assignor to the Hersey Manufacturing Co. of Portland, Me., and of Boston, Mass.

470,382 Safety cut-out; Max Kerstein, Boston, Mass.

470,402 Regulating socket or holder for incandescent electric lamps; Elias E. Ries and William S. Horry, Baltimore, Md., assignors to the Ries Electric Specialty Co., same place.

470,417 Insulator for trolley wires; William S. Andrews, New York, and Henry P. Ball, Brooklyn, assignors to the Edison General Electric Co., New York, N. Y.

470,418 Electrically heated oven. 470,419 Electric oven; John V. Capek, New York, N. Y., assignor of one-half to Edward H. Johnson, same place.

470,428 Electric store service apparatus; Midbury W. Hassan, Rochester, N. Y.

470,441 Electric current meter; Johan W. T. Olan, New York, N. Y., assignor of one-half to Edward H. Johnson, same place.

470,455 470,456 Magnetic ore separator; Charles T. Thompson and Richard H. Sanders, Philadelphia, Pa.

470,471 Incandescent electric lamp; Augustus C. Carey, Lake Pleasant, Mass.

470,477 Phonograph; Francis M. Criswell, Washington, D. C., and James A. E. Criswell, Brooklyn, N. Y.; said James A. E. Criswell assignor to said Francis M. Criswell.

470,478 Automatic heat signaling device; Willard G. Day, Baltimore, Md.

470,505 Electric car brake; John Redwood, Seattle, Wash.

470,514 Lightning conductor; Harvey Simpson, Kenosha, Wis.

470,516 Electric locomotive; Elmer A. Sperry, Chicago, Ill.

470,521 Electric generator; Charles J. Van Depoele, Chicago, Ill.

470,552 Galvanic battery; John H. Davis, Detroit, Mich., assignor to the Electrical Fiber Carbon Co., same place.

470,557 Telegraph relay; Charles M. Dyer, Cloverdale, Ind.

470,596 Electric circuit closer; George W. Price, Baltimore, Md.

470,608 Electric dust collector; Richard E. Wardhaugh, Jacksonville, Ill., assignor of one-half to William W. Allis, Milwaukee, Wis.

470,627 Electric locomotive; Sidney P. Hollingsworth, Washington, D. C.

470,634 Telephone; William A. West, Bellefontaine, O., assignor of two-thirds to W. H. West and C. G. West, same place.

470,638 Electric search-light; Robert S. Dobbie, Brooklyn, N. Y.

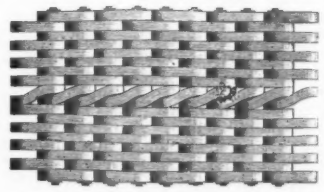
JOHN A. BARRETT,

ELECTRICAL ENGINEER & EXPERT,

13 PARK ROW,

Room 28. NEW YORK.

LEATHER LINK BELTING.



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